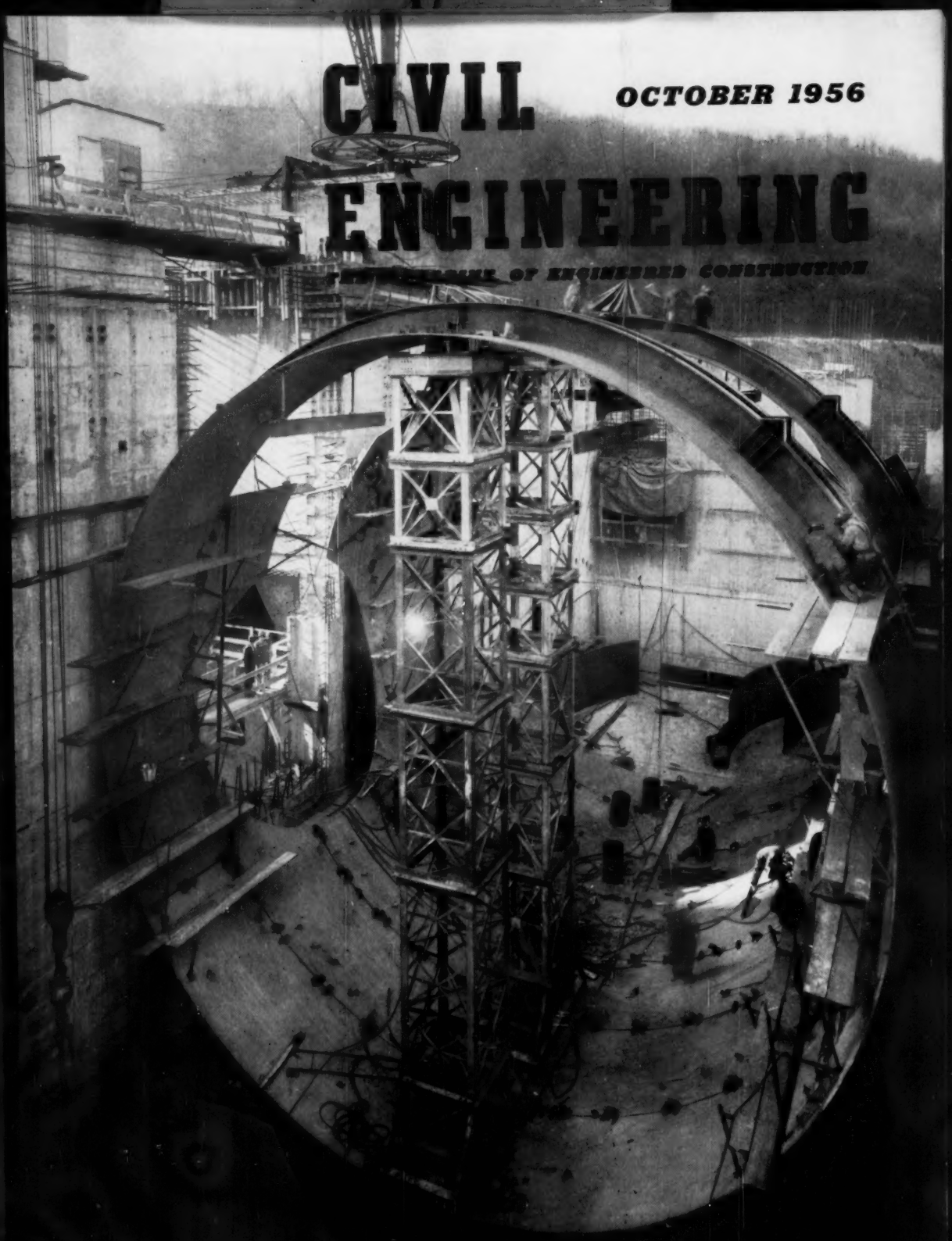
CIVIL ENGINEERING

OCTOBER 1956

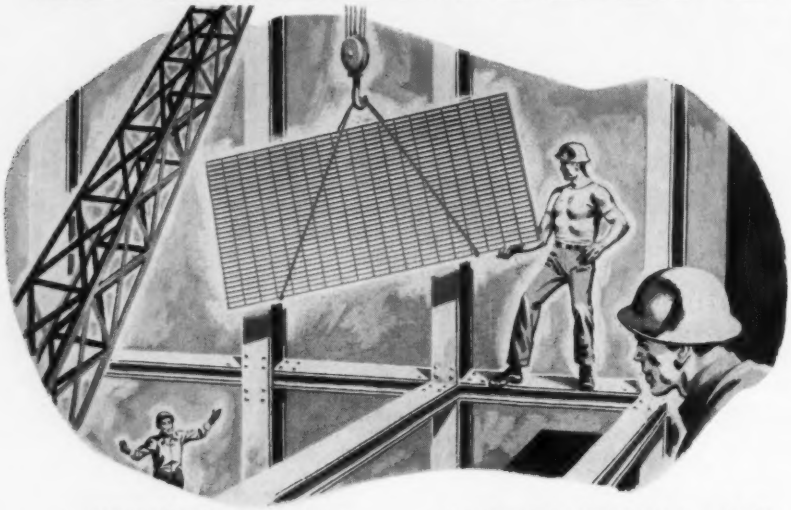
THE MAGAZINE OF ENGINEERED CONSTRUCTION

ANNUAL CONVENTION ISSUE



AUXILIARY CONTAINER ERECTED AT SHIPPINGPORT NUCLEAR POWER STATION, PITTSBURGH—SEE ARTICLES BY DONWORTH, EVANS, CONWELL

BUILDING?



? INDUSTRIAL PLANTS
? POWER HOUSES
? PUBLIC UTILITIES
? PUBLIC BUILDINGS
? COMMERCIAL BUILDINGS
? PETRO-CHEMICAL UNITS
? BRIDGES
? HIGHWAYS
? SHIPS
? HOUSING

WHATEVER YOU ARE BUILDING

. . . there may be a grating application that can save you time and money and improve the project. As founders of the grating industry, with over half a century of experience, the Irving Grating Company is well qualified to recommend designs to help you solve specific problems.

We are manufacturers of Riveted, Pressure-locked and Welded Gratings in Steel, Aluminum and other metals.

TYPICAL USES OF IRVING GRATING:

Open Steel Flooring
Safety Treads
Floor Armoring
Walkways
Trench Covers
Balconies
Loading Platforms
Vestibule Mats
Sun Deflectors
Bridge Decking
Draingrates
Contour Retainer Grid for Refractory Shells

SOME OF THE ADVANTAGES:

Self-Cleaning
Self-Draining
Permits passage of light and air
Lightweight
Strong
Will last indefinitely
Fireproof
Resists Corrosion
Simple to Install
Minimum maintenance
Custom built

"A FITTING GRATING FOR EVERY PURPOSE"

IRVICO®
ESTABLISHED 1902

IRVING SUBWAY GRATING CO., Inc.
ORIGINATORS OF THE GRATING INDUSTRY

Offices and Plants at:
5008 27th St., LONG ISLAND CITY 1, N. Y.
1808 10th St., OAKLAND 20, CALIFORNIA

Representatives in Canada, Mexico and South Africa

CIVIL ENGINEERING, October 1956. Vol. 26, No. 10. Published monthly by the American Society of Civil Engineers. Publication office 20th and Northampton Streets, Easton, Pa. Editorial and advertising departments at ASCE Headquarters, 33 West 39th St., New York 18, N. Y. Entered as second class matter September 23, 1930, at the Post Office, Easton, Pa., under Act of August 24, 1912, and accepted for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized on July 5, 1918.

Editor • Walter E. Jessup
Executive Editor • Robert K. Lockwood
Associate Editor • Ruth G. Campbell
News Editor • Mary E. Jessup
Assistant Editor, Production • Anita G. Newman

Advertising Manager • James T. Norton

Drafting • Frank J. Loeffler

EDITORIAL & ADVERTISING DEPARTMENTS of ASCE Headquarters, 33 West 39th Street, New York 18, N.Y.

Advertising Representatives
are listed on Index to Advertisers page

Subscription Rates—Price 50 cents a copy. $5.00 a year in advance; $4.00 a year to members and to libraries; and $2.50 a year to members of Student Chapters. Canadian postage 75 cents, and postage to all other countries outside of the United States and possessions, $1.50 additional.

Member Audit Bureau of Circulations
45,200 copies of this issue printed

CIVIL ENGINEERING

OCTOBER 1956
VOL. 26 • NO. 10

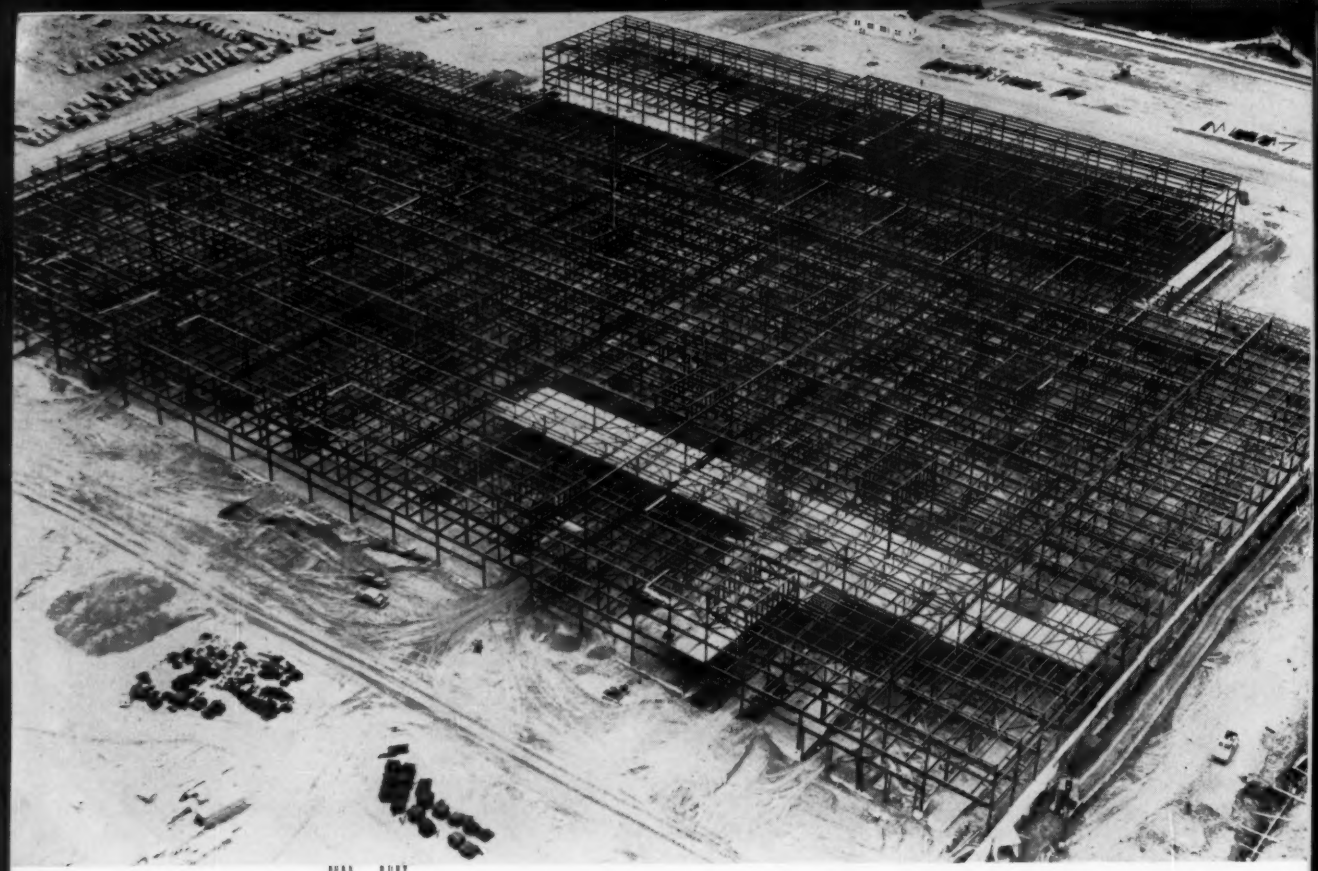
THE MAGAZINE OF ENGINEERED CONSTRUCTION

• ARTICLES

• SOCIETY NEWS

• NEWS BRIEFS

• DEPARTMENTS



MILES OF STEEL STRENGTH IN THE MERRIMACK VALLEY

Miles of steel — 51 hundred tons of it — were fabricated by The Ingalls Iron Works Company for this giant, modern Western Electric plant at North Andover, Mass., in the Merrimack Valley. Once again, Ingalls-fabricated steel has been specified on a major job!

Hundreds of important industrial planners throughout the United States depend on The Ingalls Iron Works Company for the fabrication of steel for their new buildings, bridges, power houses, and other needs. In many cases, The Ingalls Steel Construction Company handles the erection of our steel — including plate work, supplied by Birmingham Tank Company. We congratulate Western Electric on its major expansion, and take pride in serving in America's strong industrial growth.

FABRICATING STEEL
IS OUR BUSINESS!

THE INGALLS

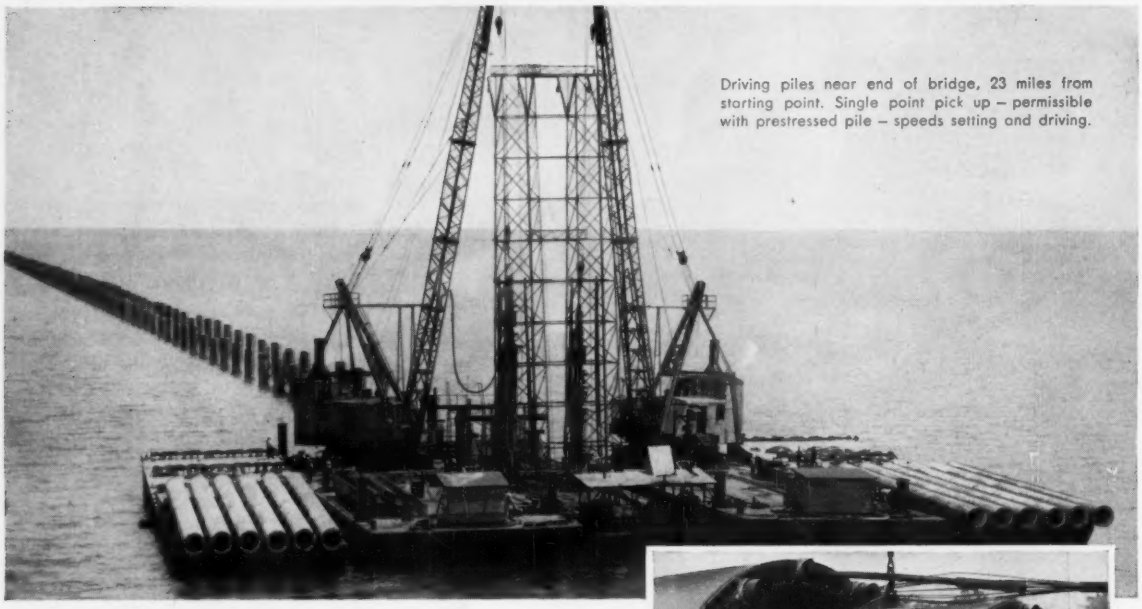
IRON WORKS COMPANY

BIRMINGHAM, ALABAMA

SALES OFFICES: New York, Chicago, Pittsburgh, Houston, Atlanta, New Orleans

PLANTS: Birmingham, Ala.; Verona, Pa.; Pascagoula, Miss.; North Birmingham, Ala.; Decatur, Ala.

PRESTRESSED CONCRETE
10th ANNIVERSARY



Driving piles near end of bridge, 23 miles from starting point. Single point pick up – permissible with prestressed pile – speeds setting and driving.

TEN YEARS AGO this month the first successful application of prestressed concrete in the U. S. was completed – the prestressed concrete portion of Roebling's Chicago Warehouse. Four years later the first prestressed concrete bridges in this country were completed – tensioned, of course, with Roebling materials. And during that interval we increased our knowledge through constant research plus the design and fabrication of prestressed concrete decks on several of our Central and South American suspension bridges.

As this new material has caught on with ever-increasing rapidity, engineers and fabricators have turned to us for information on materials and methods. This collaboration has not only helped *them* but has kept *us* constantly abreast of new developments and new requirements in tensioning elements.

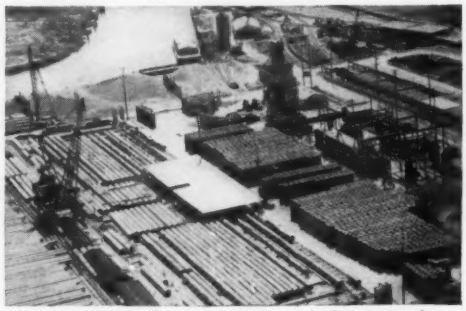
An example of Roebling's position as America's foremost supplier of tensioning materials is the Lake Pontchartrain Bridge, utilizing 123,000 miles of .192" diameter Roebling wire for prestressing the piles supporting this 24 mile long structure.

When you need tensioning materials or have a problem in prestressed concrete, why not turn to headquarters for suggestions and advice on specific applications? Contact Construction Materials Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

•

Builders; Louisiana Bridge Co., Mandeville, La. (a joint venture of Brown & Root, Inc., Houston, Texas and T. L. James & Company, Inc., Ruston, La.). Designers, Palmer & Baker, Inc., Mobile, Alabama.

Post-tensioning the cables. Piles are 54" outside diameter, 80 and 96 feet long, and stressed with 12 cables each containing 12 wires, .192" in diameter.



Louisiana Bridge Company casting yard where more than 900 feet of the Cen-Vi-Ro type piles were fabricated per day under special license agreement with Raymond Concrete Pile Company of New York.

ROEBLING

Subsidiary of The Colorado Fuel and Iron Corporation

cast iron pipe

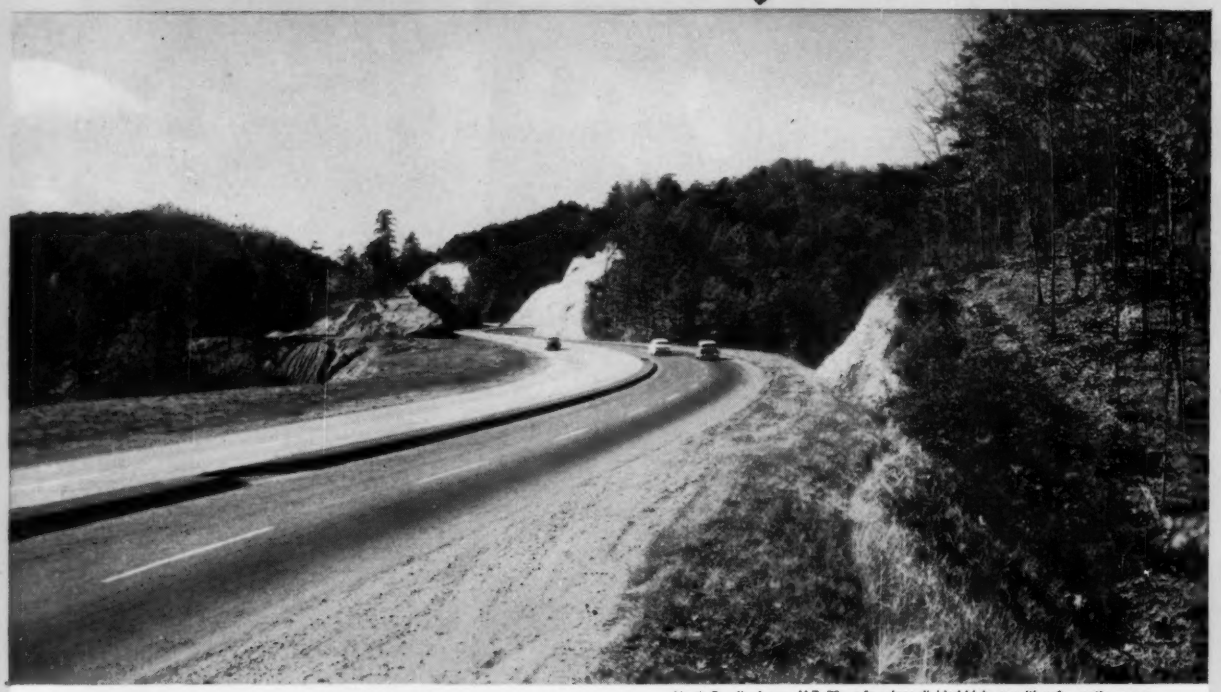
Cast iron 36" discharge line installed in South Essex Sewerage District Pumping Station, South Essex, Mass.

8,000 feet of 16" mechanical joint cast iron pipe for feeder gas main in Forest View Subdivision, Chicago, Ill.

SERVES FOR CENTURIES...

This advertisement appeared in *The Saturday Evening Post*, Sept. 29, 1956.

ADVERTISING



North Carolina's new U.S. 70—a four-lane divided highway with safe, gentle curves.

BLACK MOUNTAIN GRADE WAS A KILLER

Driving the old U.S. 70, east of Asheville, Paul Smith used to dread those hairpin turns. Now, on one of North Carolina's most spectacular highways, he makes the 1000-foot climb safely—in one third the time!

The mountain ranges of North Carolina rise out of the Piedmont like the side of a roof. When the original U.S. 70 was built, 30 years ago, its two narrow lanes of concrete scaled Black Mountain by a series of switchbacks. In the eight miles between Old Fort and Ridgecrest, there were 84 turns so sharp that trailer trucks could barely negotiate them. The roadside cliffs were scarred by many crashes.

Paul Smith, local businessman, says, "Only a year ago the best time I could make on that stretch was 20 minutes, and I drove it with my heart in my mouth." Today North Carolina's Highway Commission has relocated the route, building a four-lane divided expressway that cuts the distance to 5.7 miles, the time to 6¼ minutes. Long, sweeping curves and easy grades, none steeper than 6%, permit a safe speed limit of 55 miles an hour.

Those huge cuts and fills cost a lot of money, but everyone agrees now that it's worth it.

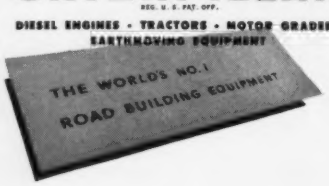
North Carolina has a progressive highway program. Its secondary system is one of the best in the country; and in proportion to area and population its 32,100 miles of paved roads lead all other states. Yet an estimated $610,000,000 needs to be spent on primary highways in the next decade. Federal highway aid will bring closer the dates when interstate expressway sections will be open to traffic. However, the basic problem of financing these and all other roads remains with the states.

Good roads save more than they cost—in time, in lives, and in actual cash. For proof, and for suggestions on how you can help, write for free booklet, "Road Block." Send a card today to Dept. 10, Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

CATERPILLAR

REG. U. S. PAT. OFF.

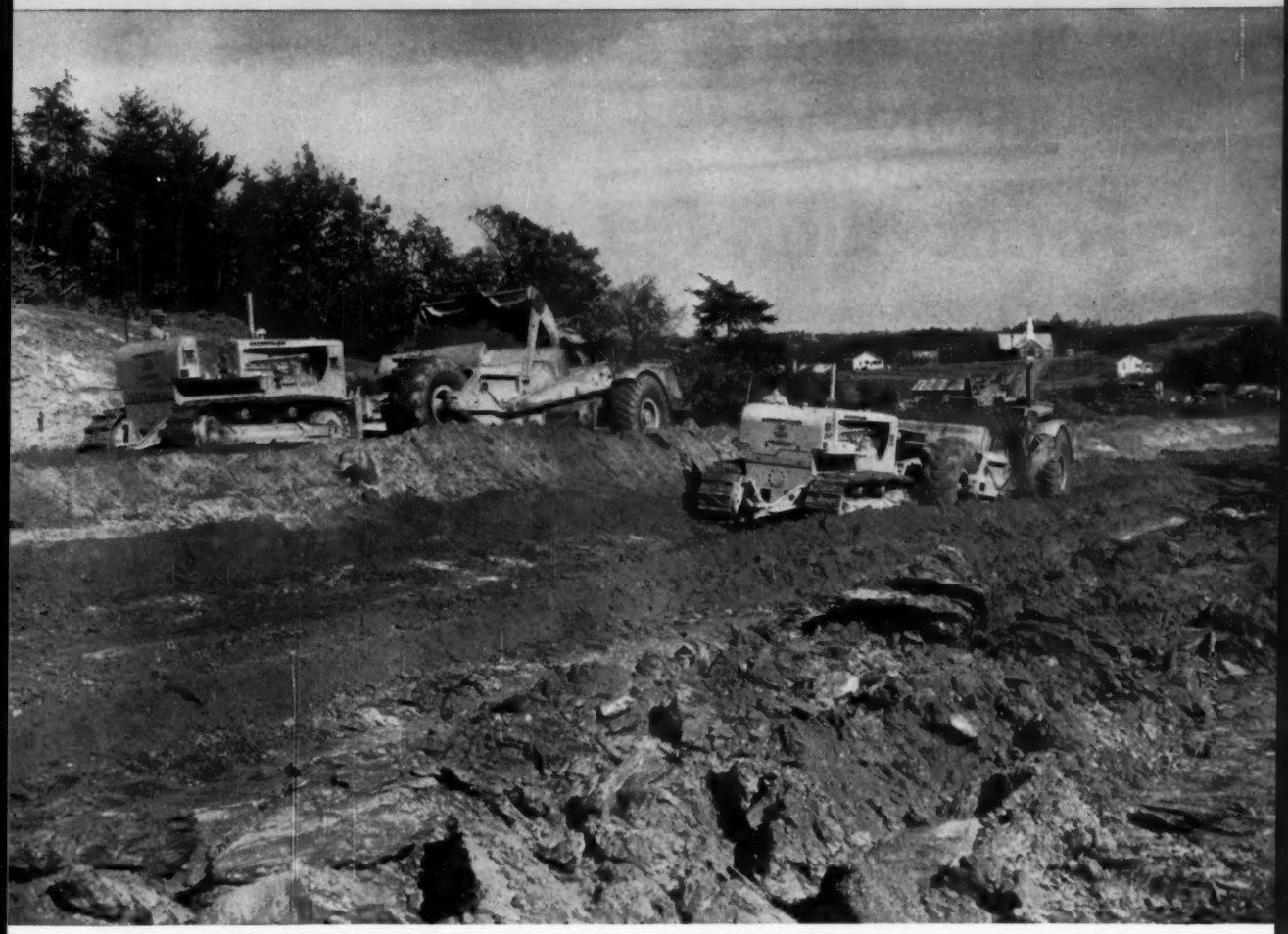
DIESEL ENGINES • TRACTORS • MOTOR GRADERS
EARTHMOVING EQUIPMENT



Old U.S. 70—a narrow two-lane road with 84 hairpin turns.

Wherever you see Caterpillar machines working on your roads, you can be sure your state is getting its money's worth.

THAT BACKS THE ROADS YOU BUILD



The powerful impact of advertisements like the one on the opposite page, running in full color in *The Saturday Evening Post*, has helped rouse America to the need for new highways. Building them is your business. And you can build them faster and at lower cost today because of the great new equipment Caterpillar puts at your disposal.

In the same region of North Carolina described in the *Post* advertisement, Asheville Contracting Co. is using Cat* DW21 Tractors and No. 21 Scrapers, push-loaded by D8s. In the photograph they are shown at work on the construction of a new section of U. S. 70, bypassing Morganton and Hickory, N. C. It's a job that requires moving 3,500,000 cu. yd. of clay and shale rock, with plenty of deep cuts and fills.

Superintendent W. W. Ledbetter says: "In twelve years using construction equipment, it is my opinion that Caterpillar builds the best. It's more dependable—more economical—and there's good dealer service."

Caterpillar research, engineering and manufacturing are geared to a single goal: to provide you with constantly improved machines—to help you do more work and make more profit. Year by year they give you greater power and efficiency, longer work life. And Caterpillar Dealers back you with reliable service and parts you can trust.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

CATERPILLAR*

*Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

LEADERSHIP IN ACTION

THE BUFFALO-SPRINGFIELD K-45 KOMPACTOR

How to select compaction equipment

The logical question to ask yourself when you are ready to buy new compaction equipment is: "Exactly what do I need the equipment for and how will I use it?"

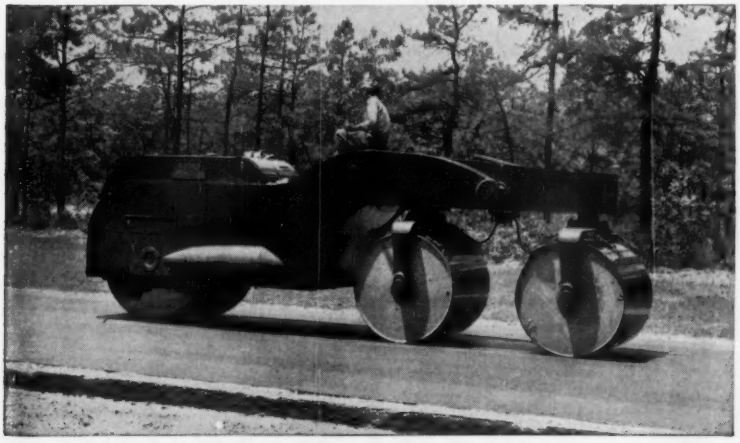
BASE FILL COMPACTION—This type of compaction demands equipment that will handle a wide variety of materials, give you the highest degree of compaction with the fewest passes. Buffalo-Springfield's revolutionary K-45 Kompactor is proving a real money-making answer for this type of work. It is self-propelled, relies on the "Interrupted Pressure Principle." All compaction effort is directed downward. Contractors testify they are meeting density requirements in one-fourth the time normally required with other compaction equipment.

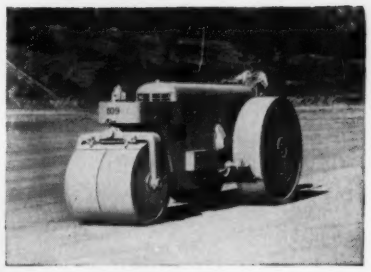
FINE GRADE FINISHING—Buffalo-Springfield offers six 3-wheel rollers, ranging in capacity from 5 to 15 tons, to handle the large variety of materials found in fills, subgrades and unfinished bituminous pavements. The variable-weight 3-wheel roller is ruggedly built for years and years of hard, maintenance-free work.

Buffalo-Springfield's thoroughly-proved 3-axle tandem "walking beam" roller provides up to 60% greater tonnage compacted per day in superhighway construction, airport and military establishment jobs where specifications are extra strict.

ASPHALT FINISHING—Two-axle Tandem Rollers are designed especially for all surface finishing jobs. Ranging from 5 to 16 tons, Buffalo-Springfield Tandems are used for heavy-duty highway and public works projects, and all types of finishing, maintenance and repair work. A wide selection of models for the biggest to the smallest jobs are designed for long-life and profitable operation.

THE BUFFALO-SPRINGFIELD KX-3 AXLE TANDEM





3-WHEEL ROLLERS

TWO AXLE TANDEMS

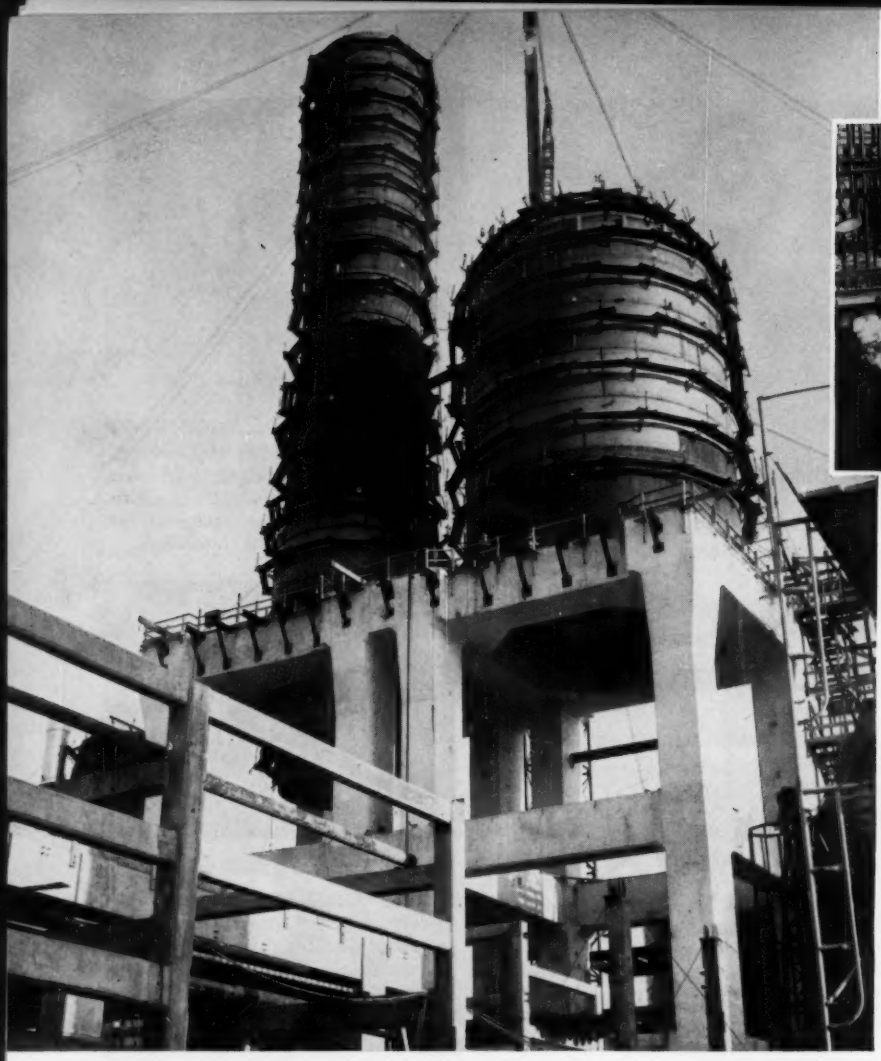
SHORT ROLLING JOBS—Buffalo-Springfield's 3-5 ton portable roller is widely used for rolling driveways, sidewalks, parking and playground areas, and for patching and light finishing jobs. It is highly maneuverable and portable from job-to-job. Write today for full information on the type of equipment you need—or see your nearest distributor for an on-the-job demonstration.

3-5 TON PORTABLE TANDEM

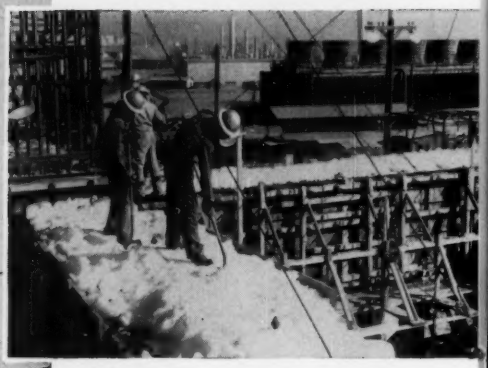
The Standard of Comparison

BUFFALO SPRINGFIELD

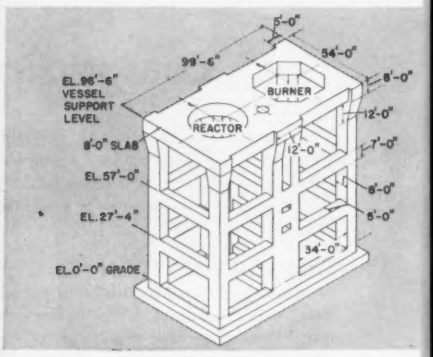
SPRINGFIELD, OHIO



Consulting Engineer: Prof. R. E. Davis
Designer and Builder: Bechtel Corporation



ICE BATH—To reduce thermal shrinkage, crushed ice was used for cooling preplaced aggregate and mixing water. Design called for closely spaced reinforcing and special aggregate to get 4000-psi concrete at 60 days.



SPACE FRAME—Mammoth PREPAKT concrete structure supports two heavy pressure vessels, withstands 16,000-ton operating load and 1,400-ton horizontal design thrust.

use of Prepakt concrete simplifies building of massive space frame

Shrinkage Controlled by Preplacing Aggregate and Precooling Materials with Crushed Ice

To assure high quality concrete in a huge, heavily reinforced space frame for the world's largest fluid coker, this structure was built of PREPAKT concrete. This was at Tidewater Oil Co.'s Avon Flying A Refinery, Associated, Calif.

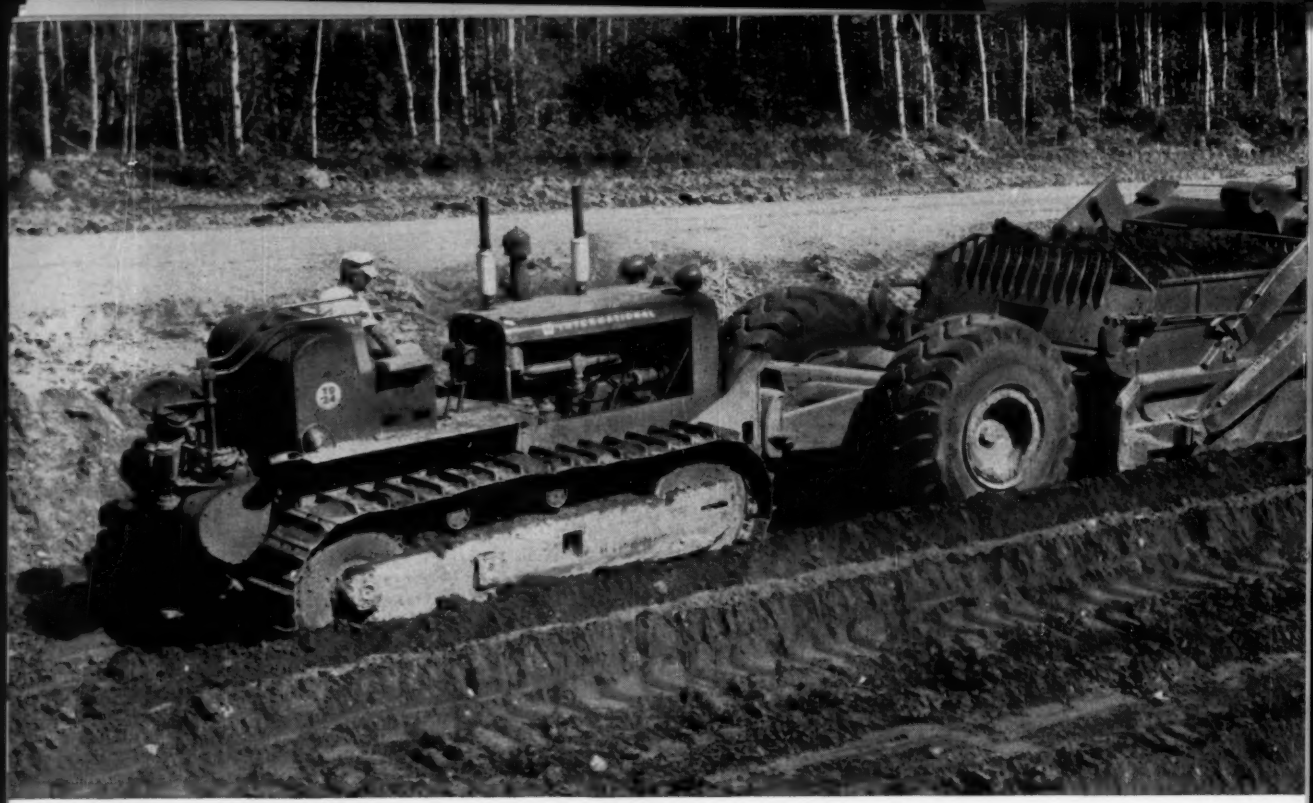
The space frame was designed with 900 tons of reinforcing to provide strength to take the tremendous equipment and earthquake loads. Placing mass concrete among the maze of 2⅛-in. bars during hot summer weather posed problems which could not be solved with conventional concrete—controlling shrinkage; avoiding honeycomb, voids and segregation; and preventing thermal cracking.

These were solved by (1) using the INTRUSION-PREPAKT method of placing concrete, (2) precooling all materials and (3) using dense, low-absorptive aggregate. Tons of crushed ice melted through the preplaced aggregate to chill it before it was consolidated with cold INTRUSION mortar. This cooling plus point-to-point contact of the aggregate minimized shrinkage.

This high-strength space frame was placed in three lifts . . . and demonstrates the remarkable results achieved by INTRUSION-PREPAKT, specialists in concrete construction and maintenance. For information, write: INTRUSION-PREPAKT, Inc., Room 779-P, Union Commerce Bldg., Cleveland 14, Ohio. In Canada: INTRUSION-PREPAKT, Ltd., 159 Bay St., Toronto, Ontario.

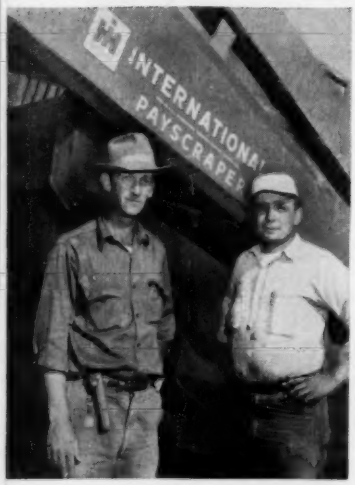
INTRUSION-PREPAKT, INC.

OFFICES IN PRINCIPAL U. S. AND FOREIGN CITIES



"Years of lowest downtime"

back preference for schedule-beating International® Equipment . . .



Foreman Milton D. Peterson and Supt. H. L. Radandt beside one of Radandt's new Payscrapers.

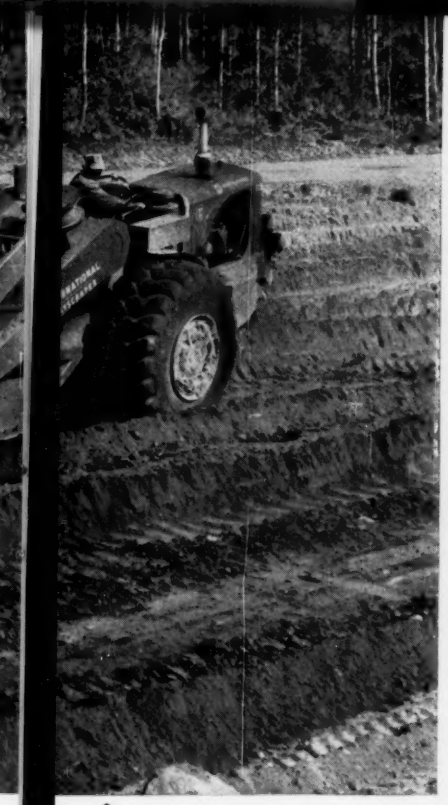
It's a $394,000 relocation and regrading job of Wisconsin 27, between Ojibwa and Ladysmith—involving clearing, grading, culverts, and sand gravel fill up to base course. Approximately ½ million cu. yds. of excavation and borrow to do.

Cuts as deep as 21 feet are required—and one 32-foot fill is necessary, because of a 22-foot deep marsh excavation, to base new road on firm footing.

A 12-unit International prime mover fleet—pushers, dozers, rubber-tired Payscrapers®, and crawler-scraper team—is what Contractor H. F. Radandt, Inc., banks on to "wind 'er up," ahead of the Wisconsin winter, with a profit!

"Have been using International crawlers since 1946," states Supt. H. L. Radandt, for the contracting firm. "Presently we have nine International crawlers and three Payscrapers in the fleet. Years of actual operation have proven International equipment had given us good service with lowest downtime. We do all our own repair work, and International design is simple to work on."

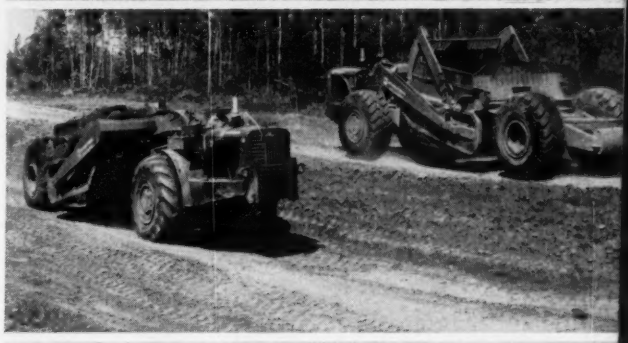
Prove how exclusive Planet Power steering with full-time live power on both tracks, plus finger-tip operating ease, give the International TD-24 exclusive production-boosting advantages! Compare capacity of new bonus-powered International equipment to anything else on tracks or wheels. Find out what International unit assembly construction means for overhaul speed and simplicity—for reduced downtime—for new upkeep economy. See your nearby International Construction Equipment Distributor for a demonstration!



"The new design 75 Payscraper bowl loads and unloads, fast and easy," declares Supt. Radandt. "Estimated average load: 18 pay yards." Here, loading time with TD-24 as pusher, the 75 heap-loads in 45-60 seconds, in silt-sand-gravel mixture!

Dumping of the new 75 Payscraper takes only 10 seconds. Higher apron lift, and bigger apron opening assure new dumping speed and positive clean-out ability. The new Payscraper's high horsepower - to - capacity ratio permits rapid acceleration to 24 mph top speed — a big yardage-booster!

The three Payscrapers in the Radandt fleet average 2200 cu. yds. per 10 hours—on a 6300 lineal-foot round trip. "The new '75' has matched engine power to deliver the payload fast, and flotation to take roughest pit or haul-road conditions," adds Mr. Radandt.



This torque-converter TD-24 is one of three International crawlers towing scrapers on the job—hauling up to 1000 lineal feet one way. With 200 net engine hp and full-time traction power on both tracks with Planet Power steering, this outfit hauls fill dirt into one of the 22-ft. deep cuts.

Another TD-24—a veteran in the Radandt fleet—spreads and compacts fill dirt on one of the marsh-excavated spots. TD-24 Planet Power steering is particularly productive on all blade work. Full-time live power on both tracks results in faster cycles, bigger loads.

—by H. F. Radandt, Inc.,

Eau Claire, Wisconsin

See you at
the ROAD SHOW—CHICAGO
Jan. 27 to Feb. 4, 1957

INTERNATIONAL HARVESTER

INTERNATIONAL® Construction Equipment

International Harvester Company, 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Pipe-Boom Tractors . . . Self-Propelled Scrapers and Bottom-Dumps . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Trucks . . . Diesel and Carbureted Engines . . . Motor Trucks

Another city *using* AMERICAN'S *reinforced concrete pressure pipe for water supply lines*

The City of Phoenix, Arizona is another of the rapidly growing cities of the Southwest which have faced tremendous water supply problems and have met them successfully. The population of Greater Phoenix has increased almost 50 per cent in the past five years. An annexation program is currently increasing the rapid expansion of the City of Phoenix which is one of the fastest growing cities in the nation.

During 1953 American Pipe and Construction Company, through Fisher Contracting Company, general contractors, supplied Phoenix with more than 37,000 feet of large diameter concrete pressure pipe for a line which increased the Phoenix primary feeder capacity from 100,000,000 MGD to 210,000,000 MGD. The pipe furnished was pre-stressed concrete cylinder pipe designed for the operating pressures established under specifications prepared by Yost & Gardner, consulting engineers for the City of Phoenix.

American has helped to meet the special problems faced by Phoenix water officials by designing and supplying reinforced concrete pressure pipe especially for conditions in the Phoenix area.

A recent merger with Hooper Concrete Pipe Company in Phoenix gives American another permanent plant from which to serve the cities of the Southwest.

American Pipe and Construction Company makes available 49 years of experience and extensive production facilities to help solve any water supply problem. There is a type of American pipe to meet any requirement. Write or phone for complete information.

5605

American PIPE AND CONSTRUCTION CO.

Concrete pipe for main water supply lines, storm and sanitary sewers, subaqueous lines

Mail address:
Box 3428 Terminal Annex, Los Angeles 54

Main offices and plant:
4635 Firestone Blvd., South Gate, Calif., Phone LOrain 4-2511

District sales offices and plants:
Hayward and San Diego, Calif., Portland, Ore., Phoenix, Ariz.

Berger Transit narrows problems on world's widest vehicular tunnel

Deflections. Angles. Curves. Each construction job contributes its share. But the 13½ million dollar tunnel section of Boston's new J. F. Fitzgerald Expressway had them in spectacular abundance. And when V. Barletta Co. of Roslindale, Mass., was awarded this big contract, they knew that the instrument needed to see them through the job would have to be tops in accuracy and dependability. That's why they chose the BERGER 6¼" Bronze Transit.

Here's an idea of some of the problems they met:

On the approach to the slab area, some 20,000 yards of concrete—over 90 separate pours—were held to within 1/100th of a foot.

Where the approach goes underground, the base lines of the steel structure are on a series of curves. These base lines—and all points on both sides of the structure—were run 15 to 20 times to assure absolute accuracy. Anchor bolts were set within 1/16". Pre-cut steel beams had to fit exactly. They did.

Problems of laying out, alignment, elevation, leveling—the BERGER Transit was given a complete workout, day in and day out.

Said Barletta Co. engineers: "It does the job—and then some. Graduations stand out clearly for easy reading. Telescope focuses quickly over long and short distances—from 100 to 500 feet in only half a screw turn. Easy to center over a point from 15 to 20 ft. height. No problem picking up targets—even at 1200 feet."

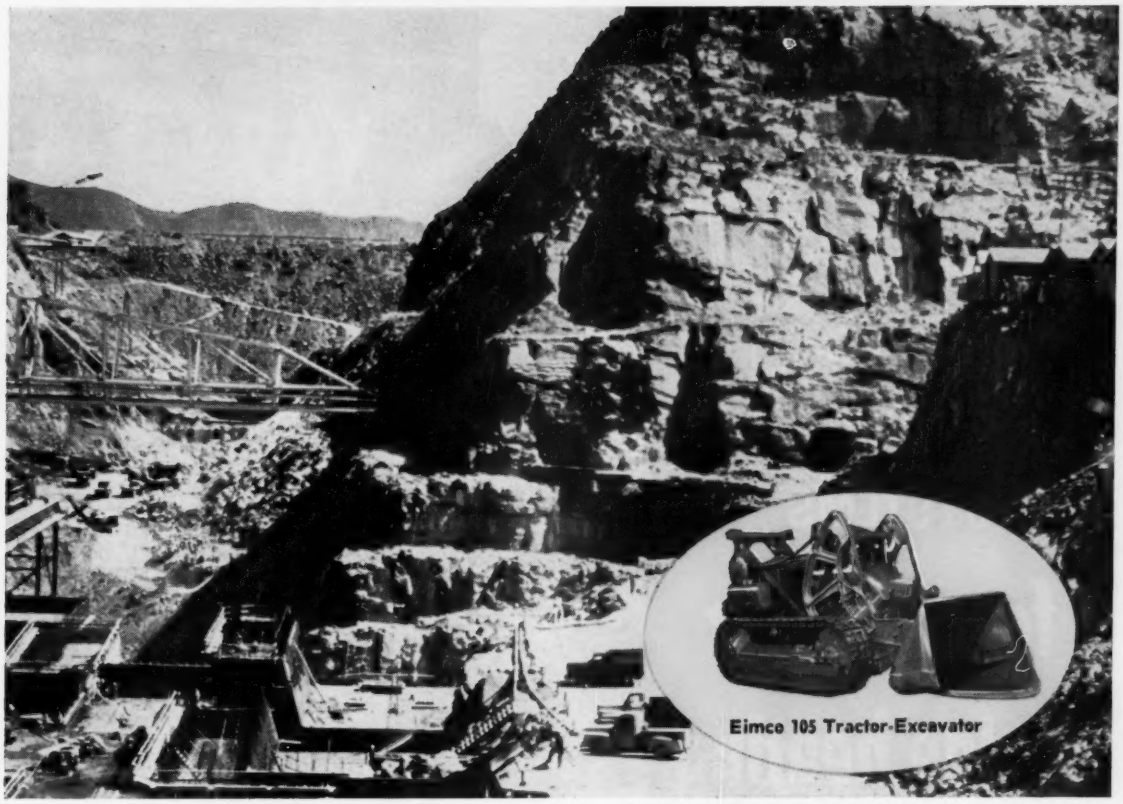
Where accuracy is at stake, leading engineers and construction men buy BERGER. Put yourself behind a BERGER—and see why. C. L. BERGER & SONS, INC., 51 Williams St., Boston 19, Mass.

Write for a copy of "ACCURACY IN ACTION"

Engineers' Transits
Builders' Instruments
Levels
Alidades
Theodolites

THE BEST IN SIGHT IS BERGER

ENGINEERING AND SURVEYING INSTRUMENTS...SINCE 1871



INDIA – EIMCO 105's KEEP GRUELLING SCHEDULE

Two Eimco 105 Tractor-Excavators have each worked 8,000 hours in 12 months to keep progress on schedule at a huge dam project in India.

The machines have received intelligent maintenance and repairs have been small.

Eimco 105 Tractor-Dozer

At work on diversion, penstock and highway tunnels, trained Indian crews operating the 105's are doing an excellent job of tunnel driving. In some instances, advance for the size of tunnel being excavated may establish new world records.

"Eimco 105's are preferred equipment to use for tunnels of this type," says one official of a contracting firm. "The transmission, clutches and drive on both machines have not been touched in 8,000 hours of operation. They are in good condition and we expect them to last many more years."

Have you considered why the Eimco 105 is "preferred equipment" to contractors of huge dam, tunnel and road projects in the export market?

It's becauuse their dependability is reflected through their engineered strength to stay on the job around the clock – day in and day out.

The Eimco 105's dependability eliminates the necessity of a sizeable parts depot. Eimco's are built to 100,000 hour standards for service in remote areas. Time saved by Eimco's working continuously with no down time for repairs is a big factor in selecting equipment.

Conditions being equal, Eimco 105's will produce more at less cost and in less time than comparative equipment. Let Eimco show you how this versatile unit can outperform and out-work heavier, more expensive units.

See the Eimco 105 before you buy any crawler tractor equipment.

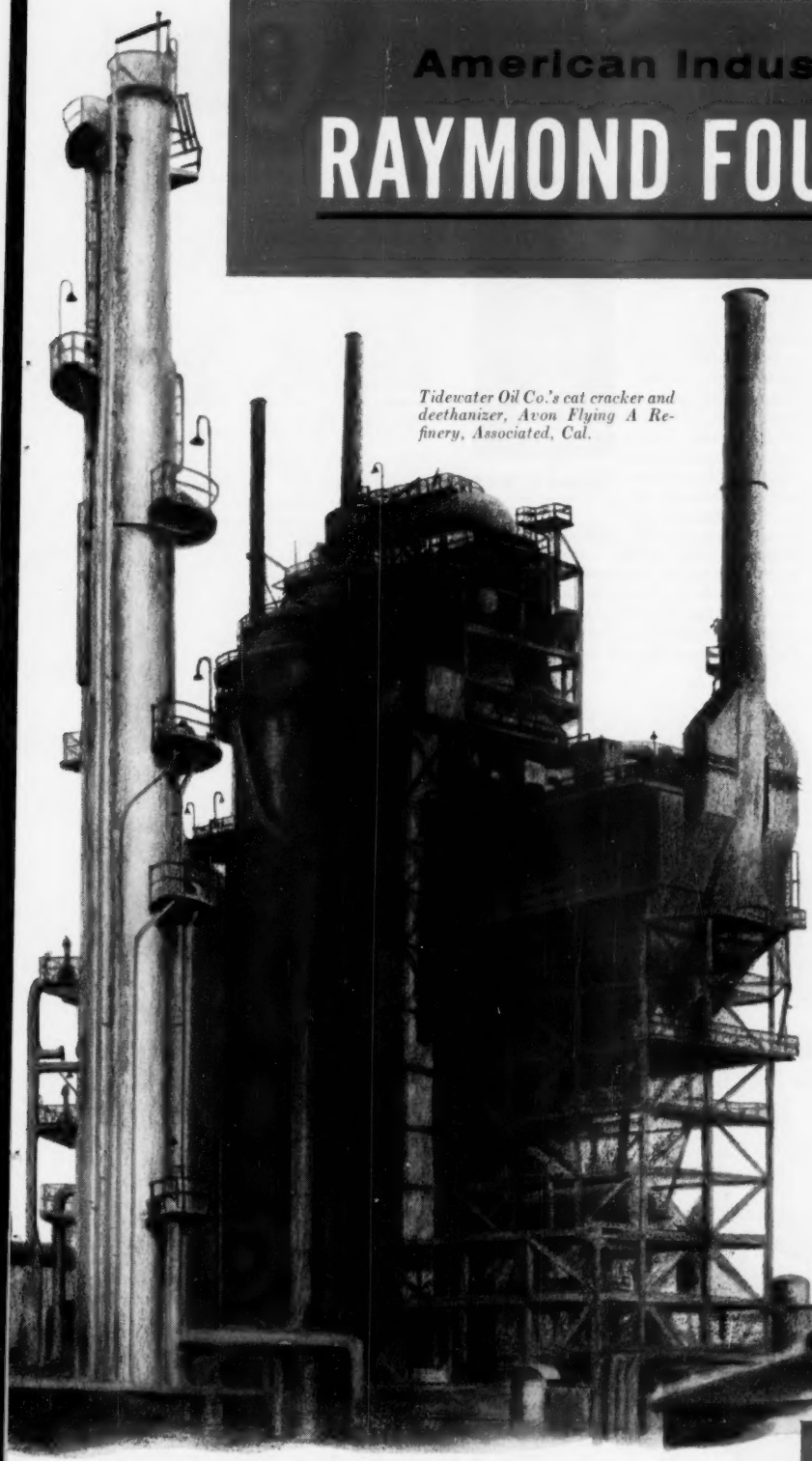
THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Cleveland, Ohio Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-214

American Industry rests on
RAYMOND FOUNDATIONS



Tidewater Oil Co.'s cat cracker and deethanizer, Avon Flying A Refinery, Associated, Cal.

take
OIL
for example

OIL . . . the lifeblood of our civilization is continually expanding to fulfill tomorrow's demands today. And helping the industry to meet this dynamic expansion has been Raymond's role for over 50 years. You'll find Raymond foundations supporting off-shore structures, tanker wharves, "cat crackers" and storage tanks just about everywhere oil is drilled, pumped and refined. In all, Raymond has handled 189 contracts for domestic oil companies in the past 10 years alone. This includes projects for such leaders in the field as Standard Oil, Gulf, Tidewater and Sinclair, to mention a few. If you have a foundation or heavy construction problem, whatever industry you're in, we'll be happy to discuss it with you.

RAYMOND AT HOME AND ABROAD

AROUND THE WORLD FOUNDED 1897

IN THIS COUNTRY
Foundations . . . Marine Structures . . .
Heavy Construction . . . Soil Investigations.
OUTSIDE THE UNITED STATES
Complete services for all types of construction.

RAYMOND
CONCRETE PILE CO.
140 Cedar St. • New York 6, N. Y.
Branch offices in Principal Cities of the United States, Canada, Central and South America.

NEWS OF ENGINEERS

Harvey F. Ludwig resigned in September as sanitary engineer director of the U. S. Public Health Service to accept a position with Hycon Aerial Surveys, Inc., in Pasadena, Calif. Since 1953 Mr. Ludwig has served as chief of the Office of Engineering Resources, USPHS, concerned with such activities as establishing a career development program for Public Health Service engineers and promoting sanitary engineering research throughout the United States. In his new position he will be involved in photogrammetry, geophysical explorations, and other services provided through the medium of aerial measurements.

Lawrence S. Waterbury announces the opening of an office for the practice of consulting engineering, following his retirement as a general partner in the engineering firm of Parsons, Brinckerhoff, Hall & Macdonald, which he will continue to serve as a consultant. His offices will be located at 26 Broadway, New York City.

George Albert Lyon, registered architect and engineer, has opened an office at 1625 East Camelback Road, Phoenix, Ariz. He formerly had offices in Logan, Utah.

Richard B. Ward, who was resident engineer for the Metropolitan Water District of Southern California from 1931 to 1938 on construction of the District's dam and dike at Lake Mathews, its terminal reservoir, has returned to the District to be in charge of increasing the capacity of Lake Mathews from 107,000 to 215,000 acre-ft. During the intervening years he has been construction engineer for the Bureau of Reclamation and the U. S. International Boundary and Water Commission on many important water supply projects. For the past two years he has been employed by the Bureau of Reclamation as engineer adviser to the Snowy Mountains Hydroelectric Authority in Australia.

Richard B. Ward

Emil F. Vranich has joined Robert J. Strass, Inc., Professional Engineers of Milwaukee, Wis., as vice-president. **Carrol R. Maguire,** professional engineer has been named an associate. Mr. Vranich was formerly structural engineer in the City of Milwaukee Bureau of Bridges and Public Buildings and an associate engineer with several Milwaukee firms.

James C. Powell has been named engineer of the Calaveras Cement Company plant in San Andreas, Calif. Before joining Calaveras in 1955, Mr. Powell worked for seven years for the California State Division of Highways.

Robert H. Baldock, formerly state highway engineer of Oregon, is now stationed in Baghdad as chief engineer of the Edwards, Kelcey and Beck Highway Mission in Iraq. **Edward L. Worthington,** until recently chief of the mission and previously state highway commissioner of West Virginia, has returned to the states and is now in charge of the Edwards, Kelcey and Beck portion of the Connecticut Turnpike.

Paul Hartman, associate professor of civil engineering, College of the City of New York, has been elected chairman of the department of civil engineering. Pro-

fessor Hartman has been on the School of Technology staff at City College since 1936.

Sidney F. Borg, associate professor of civil engineering at Stevens Institute of Technology, Hoboken, N. J., has been promoted to professor. Dr. Borg, who is head of the department of civil engineering, was appointed to the faculty in 1952.

George D. Clyde, Commissioner of Interstate Streams for Utah, has won the Republican nomination for governor of the state. Before taking his present post, Mr. Clyde was dean of engineering and mechanical arts at Utah State Agricultural College at Logan and chief of irrigation and water conservation for the U. S. Department of Agriculture.

Moran, Proctor, Mueser & Rutledge announce the removal of their New York offices to 415 Madison Avenue, New York 17, N. Y.

Richard W. Cloues was recently promoted from assistant chief engineer to chief engineer of the Pittsburgh Bridge & Iron Works, Pittsburgh, Pa. He was formerly associated with the Aetna Steel Co. of Jacksonville, Fla., as chief engineer, leaving last year to join Pittsburgh Bridge & Iron.

Alex C. Kelley, manager of Atlantic Steel Company's Fabricating Division, has been named to the national Committee on Reinforced Concrete Research of the American Iron and Steel Institute. A licensed professional engineer, Mr. Kelley has been with the Atlantic Steel Company since 1953. Earlier he was connected with the Nashville, Chattanooga & St. Louis Railway, and with Wilson-Wilkinson, a Nashville fabricating and construction equipment firm.

Alex C. Kelley

Kenneth Simpson has been appointed district representative for the Heltzel Steel Form and Iron Company and the Flexible Road Joint Machine Company of Warren, Ohio, in eleven western states. He was formerly employed by the Noble Company and Standard Steel Company in California. His main office is at Redondo Beach, Calif., where he will handle the joint line of products.

Lowell R. Williams, former engineer with the Spreckels Sugar Co., recently joined the municipal financing consultant department of Stone & Youngberg in Los Angeles, Calif. Mr. Williams will work as a financial analyst in connection with consultant services to communities planning public improvement projects.

Raphael H. Courland, consulting engineer of New York City, announces the new location of his offices in the Central Savings Building, 212 Broadway, New York 23, N. Y.

Earle V. Miller has resigned as Idaho State Highway Engineer after four years of service and returned to Phoenix, Ariz., to join the firm of Johannessen and Girand, consulting engineers with offices in Phoenix and Tucson. He will take charge of the firm's highway division. Mr. Miller rose to assistant highway engineer of Arizona before going to Boise. He has been active in the AASHO and has served as president of WASHO.

Earle V. Miller

Benjamin B. Talley, Brigadier General, U. S. Army (retired), has been appointed project manager of the Raymond Concrete Pile Company, for which he will direct construction operations in foreign countries. For the past year he has been division engineer of the Mediterranean Division, Corps of Engineers, with headquarters in French Morocco, Africa and the Middle East, and in charge of construction in Pakistan and Iran. General Talley has been awarded the Distinguished Service Cross, the Distinguished Service Medal, and other high citations for outstanding performance of duty.

Walter R. Bjorklund has been appointed assistant chief engineer of the Northern Pacific Railway Company with headquarters at St. Paul, Minn., succeeding **Douglas H. Shoemaker,** temporarily assigned to other duties. Mr. Bjorklund was formerly district engineer at St. Paul.

Laurence G. Leach, civil engineer employee of the South Atlantic Division, Corps of Engineers, Atlanta, Ga., is attending the Water Resources Seminar now being conducted at Harvard University for the year 1956–1957. Mr. Leach, who is chief of the Hydraulic Section, Engineering Division, has been an employee of the Corps since 1934, and in the Atlanta office since 1942. He is a graduate of Case Institute of Technology at Cleveland, Ohio, class of 1932. Of the ten engineers selected to attend this seminar, Mr. Leach is one of the two representatives of the Corps of Engineers.

Richard L. Mann, Captain, U. S. Navy (retired), has joined the staff of Gamble, Pownall and Gilroy of Fort Lauderdale, Fla., as coordinator of administration and planning. He will be responsible for the administration of production progress and financial analysis with the firm's clients and for coordination of design and plans. Captain Mann has been in the Navy's Civil Engineer Corps for most of his 22 years of Naval service. Most recently he was District Civil and Public Works Officer for the 15th Naval District in the Canal Zone.

(*Continued on page 28*)

News of Engineers

(*Continued from page 27*)

Lloyd H. Carden has assumed new duties as chief design engineer in the engineering department of the Utah Construction Company, a joint venture of Utah Australia Ltd. and Concrete Construction Pty., Ltd., on an Australian Project near Sydney. For the past few years Mr. Carden has been in engineering administration work in the engineering and supply division of the Hanford Operations Office, Atomic Energy Commission, in Washington, D. C. His new address is c/o Utah Australia, Ltd., Box 4141, G.P.O., Sydney, Australia.

Robert E. Stiemke, director of the School of Civil Engineering, Georgia Institute of Technology, has been touring the British Isles and the continent by automobile. Professor Stiemke is visiting and inspecting the facilities at various universities in Scotland, England, Denmark, Sweden, Norway, the Netherlands, Belguim, Germany, France, Italy, Portugal, and Spain. He is expected to return to Atlanta the latter part of October.

Eugene L. Macdonald has retired as general partner in the firm of Parsons, Brinckerhoff, Hall & Macdonald, Engineers of New York City. He will serve as a consultant and will continue as chairman of the Board of Directors of the firm.

Leland L. Sphar has been appointed to the position of engineer-manager of the Concrete Products Association of Washington, Seattle. His work will involve technical consultation in the field of concrete sewer and culvert pipe, and concrete masonry and precast products. Mr. Sphar was formerly research engineer for the Legislative Joint Fact Finding Committee on Highways, Streets & Bridges.

John R. Snell has announced the formation of Michigan Associates, a new consulting engineering firm located at 221 N. Cedar Street, Lansing, Mich. Associated with Mr. Snell are **W. I. Kenerson** as partner, **Frank H. Theroux** and **Wesley W. Webb** as associates, and **John Willams** and **Tapeshwar Singh** as engineers. Mr. Snell was formerly head of the civil engineering department at Michigan State University and is currently serving a three-month technical mission in the Far East for the World Health Organization. The firm is successor to John R. Snell and Associates.

Benedict R. H. Winslow is one of the 1956–1957 recipients of the Automotive Safety Foundation Fellowships providing $2,000 for graduate study at the Institute of Transportation and Traffic Engineering, University of California. Mr. Winslow received his B.S. in civil engineering from Massachusetts Institute of Technology in 1954. **Michael Lash, Jr.,** has just completed his work with the ITTE under one of the A.S.F.'s 1955–1956 grants.

William H. Wisely, Executive Secretary of ASCE, recently named to honorary membership in the Federation of Sewage and Industrial Wastes Associations, will have the honor bestowed on him at the 29th annual meeting of FSIWA in Los Angeles on October 10. Honorary members in the association are persons of acknowledged eminence in the fields of sanitary engineering.

William H. Wisely

Joseph O. May, assistant district engineer in the New York office of U. S. Steel's American Bridge Division, retired recently after 46 years of service. Mr. May, who started with American Bridge as a draftsman in 1910, has supervised design and estimating on many famous construction projects. Recently he worked on the Tappan Zee Bridge over the Hudson River.

Jack E. Leisch, former chief of the Design Development Section of the Bureau of Public Roads, has joined the Chicago engineering firm of De Leuw, Cather & Company. He has been with the Bureau of Public Roads for more than twenty years. Mr. Leisch is the principal author of *A Policy on Geometric Design of Rural Highways* and other AASHO Publications.

Morris Goodkind, former director and chief bridge engineer of the New Jersey State Highway, was recently honored with the 1956 Engineering Award of the New Jersey Society of Professional Engineers during its joint convention with the National Society of Professional Engineers. Mr. Goodkind is associated with the consulting engineering firm of Goodkind & O'Dea, which has offices in Bloomfield, N. J., Hamden, Conn., and Morton Grove, Ill. He is a former Director of ASCE.

Harold Allen recently took over new duties as chief of the Physical Research Branch of the Research Division, Bureau of Public Roads, Washington, D. C. He joined the Bureau in 1937, serving in the Soils Section of the Physical Research Branch until 1945, when he became chief of the Section, and has been chief of the Nonbituminous Section of the Physical Research Branch since 1953.

Robert W. Van Houten, president of Newark College of Engineering, Newark, N. J., recently received the honorary degree of doctor of science from the Clarkson College of Technology at Potsdam, N. Y.

Luke A. Westenberger, director, Public Services Department, U. S. Civil Administration of the Ryukuys, has returned to the United States after nearly eleven years in the Far East Command. He has been transferred to the Office of the Deputy Chief of Staff, Logistics, Department of the Army, in Washington, D. C.

"Planting" Lancaster's New Water Line

Lancaster, Pa., is one city that is taking vigorous steps to solve the problem of municipal water supply. Now under way is a vast water-supply project including construction of an intake, pumping station and filtration plant on the Susquehanna River, a 15-million gal reservoir and a 10-mile steel main. Completion of the pipeline early in 1957 will add 8 million gals per day to the city's water supply. The line's ultimate capacity will be 32 million gals per day.

The job requires 55,500 ft of 42-in.-ID x $\frac{5}{16}$-in. tar-enameled steel pipe, plus specials, fabricated at Bethlehem's Steelton, Pa., pipe shop, and trucked to the job site in 40-ft lengths. The portion of the line extending 31,400 ft from the river to the reservoir is being installed by Frank Kukurin & Sons, Inc., of E. McKeesport, Pa.; the 24,100-ft section into the city by Alconn Utilities, Inc., of Verona, N. J. The entire project was engineered by Gannett, Fleming, Corddry & Carpenter, Inc., of Harrisburg, for the City of Lancaster Authority.

How about *your* water supply plans? Let us show you the many advantages of planning for the future with tar-enameled steel pipe. Remember that *every length* of steel pipe is hydrostatically tested in the shop—your assurance of its strength, safety and freedom from leaks. For further information, contact the nearest Bethlehem sales office.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

do you know that

The Annual Convention is being held in Pittsburgh? In case you missed the program (September issue) and other announcements, this will remind you that the Society is breaking with tradition this year and going to Pittsburgh for its Annual Convention. The dates are October 15–19. This issue is devoted to Convention papers on some of the exciting new Pittsburgh projects, including the Shippingport Nuclear Energy Plant, the Penn Lincoln Parkway, and the arterial route through the city.

Mason Lockwood will be our 88th President? He heads a slate of nine new officers who will be inducted during the Convention. On the Convention agenda, also, will be the presentation of ASCE prizes and conferring of honorary membership on five distinguished members. Highlights in the careers of all three groups of honored engineers appear in the Society News section of this issue.

ASCE has a new Committee on Cold Weather Construction? The organization and objectives of this important new activity of the Construction Division are described in the "Construction Division News," which also is featured in the Society News section.

If you are a Junior Member, you may have to act to continue your membership in the Society? This year more than 1,200 Junior Members must transfer to Associate Member grade by December 31 or be dropped from the Society rolls. An item in Society News explains the Junior Member's transfer privilege.

Pittsburgh is building a $100,000,000 sewerage system? The comprehensive system, which will serve 70 communities, includes a treatment plant with initial capacity of 150 mgd, 30 miles of intercepting sewers to be built in tunnels, and 33 miles of sewers to be constructed as open cut. The plant will feature a method of sludge concentration by flotation, followed by incineration of the concentrate sludge.

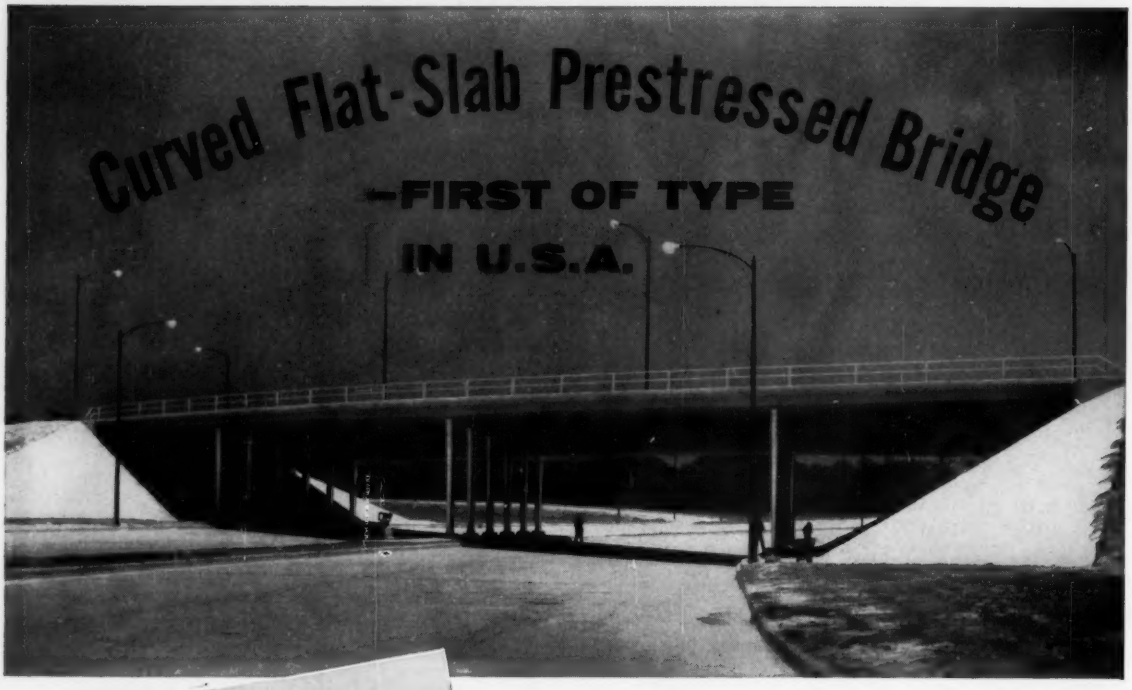
Chicago may have a mile-high 510-story office building? At the request of prominent Chicagoans, Architect Frank Lloyd Wright is working on plans for a structure, which would measure 400 by 500 ft at the base and tower 5,280 ft into the air. If the design is adopted, the building will front on Lake Michigan and will be used to house 100,000 state, city, and county employees. The tallest office building at present is the 1,472-ft-high Empire State Building in New York. Source of the report on the proposed Chicago skyscraper is a recent Central Illinois Section newsletter.

Turnpike construction goes on apace? The $280,000,000 east-west Indiana Turnpike, which has been under construction for the past two years, was dedicated on September 17. The 140-mile road connects the Ohio Turnpike with East Gary, Ind., and the final 16-mile link between East Gary and Illinois will be opened by November 15. West of the Mississippi, contractors are pushing work on the Kansas Turnpike to meet the scheduled opening date of October 15.

Delay in meeting the proposals of the Hoover Commission is costing the United States $175 a second? This is the startling estimate of the Chamber of Commerce of the United States, which reports that to date only 112, or 35 percent, of the 314 specific recommendations for federal reorganization have been put into effect. "Even so," says the Chamber, "it is estimated by the Citizens' Committee for the Hoover Report that the recommendations already being put into effect should save taxpayers $532,600,000 annually."

An electronic device will be used to learn the real facts about storms at sea? A robot "Hurricane Inspector" being built by the Gulf Oil Corporation will have the assignment of sitting through the worst Gulf of Mexico storms and reporting what happens inside them. The device will measure and record the forces of waves, winds, tides, and currents in 100 ft of water as far as 100 miles from land, with the aim of learning the strength needed in offshore drilling platforms to protect operating crews and equipment.

Civil engineers are not denizens of ivory towers? If Houston, Tex., engineers are typical, the profession can be counted on to take part in all sorts of community affairs. More than 700 of 901 engineers responding to a recent poll conducted by the Houston Branch of the Texas Section and the San Jacinto Chapter of the Texas Society of Professional Engineers said that they are active in everything from church work to leadership of youth groups.



● Use of prestressed concrete in bridge construction was extended in several directions in building this attractive bridge in downtown Houston.

The structure is a flat-slab, continuous over three sets of columns. The deck follows both horizontal and vertical curves. Column rows are skewed at different angles with respect to bridge's centerline, which is curved to a radius of 764 ft.

Despite problems created by continuity, curvature and skewed supports, the deck was prestressed with steel tendons continuous over the full 225-ft. length. This steel also undulates in a vertical plane to apply upward and downward forces that counteract bending stresses due to loads on the deck.

The new bridge carries six lanes of traffic on Waugh Drive over an extension of Memorial Drive, which it intersects at a 45 deg. angle. The flat slab deck is 72 ft. wide. Stringent clearance requirements dictated the use of flat-slab design.

The public is pleased with the beauty and utility of this unique bridge. Designer and Contractor are equally pleased with the performance of Lone Star Cement, 12,500 bbls. of which was used in this attractive structure.

WAUGH DRIVE-MEMORIAL DRIVE INTERCHANGE, Houston, Texas

Engineer:
FRANCIS J. NIVEN & ASSOCIATES, Houston

General Contractor:
CONSTRUCTORS, INC., Houston

★

Subcontractor, Prestressing:
TEXAS STRESSED CONCRETE CORPORATION
Austin

Lone Star Cement supplied by:
W. D. HADEN COMPANY, Houston

LONE STAR CEMENTS COVER
THE ENTIRE CONSTRUCTION FIELD

LONE STAR CEMENT CORPORATION

Offices: ABILENE, TEX. • ALBANY, N. Y. • BETHLEHEM, PA.
BIRMINGHAM • BOSTON • CHICAGO • DALLAS • HOUSTON
INDIANAPOLIS • KANSAS CITY, MO. • NEW ORLEANS • NEW YORK
NORFOLK • RICHMOND • WASHINGTON, D. C.

LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 18 MODERN MILLS, 38,000,000 BARRELS ANNUAL CAPACITY

Whooping cranes or whopping works?

Energy makes the world go round. Commercial atomic power plants are already under construction. The breakthrough of the economic barrier to the utilization of solar and tidal energy may come in this century. As scientists pass these "new" sources of energy along to engineers for application in the vast number of man's activities, there will be a combined need for mechanical, electrical, industrial and nuclear engineers by the hundreds of thousands—obviously. But what is going to happen to civil engineers?

As the newly applied sources of energy replace our dwindling reserves of fossil fuels—coal, oil and natural gas—will civil engineering become fossilized in the process? Is the oldest and best known branch of the profession moving into a sort of "whooping crane" era?

Actually, because these awesome and historic developments do underwrite the energy needs of the future, a vastly enlarged body of better trained civil engineers becomes an inexorable necessity. The demand for land-based works, which have challenged the imagination and ingenuity of civil engineers since the days of primeval warfare, is increased—not lessened—by the scientific upheavals of this age.

Fundamentally, for every action—including nuclear—there must always be an "equal and opposite" reaction. Fundamentally too, every man-made thing that supports this or will support any future civilization must be land based—physically supported by the earth's surface. That precisely is the realm of civil engineering. And the more populous and complex a civilization, the more demanding and involved becomes its engineering.

Achievements in the design and construction of physical works consistently have been one of the historic methods of measuring the accomplishments of a civilization—for example, the Egyptian pyramids, the Babylonian water supply and irrigation systems, the roads and aqueducts of the Romans, and the fabulous structures of the Incas, Mayas and Aztecs.

Future historians will have a harder but more exciting choice. A generation or so hence, none of the seven engineering wonders of the United States, as designated by the American Society of Civil Engineers last year, will necessarily place in a like category. There will be new wonders of unforeseeable magnitude and complexity in the program of civil works which this country will be obliged to undertake, if not to complete, in our time.

The impact of the gigantic and well-publicized highway program soon will be felt. A water-conservation, pollution-abatement undertaking of similar proportions is inevitable and imminent. The immensity of military airfield construction in progress and in prospect has obscured the grave inadequacies of civil airports. The unsatisfied transportation needs in fields other than highways—especially in waterways—are enormous. And the backlog of basic physical needs for municipal and other public improvements of every kind is immeasurably large.

These unprecedented needs for public works, the gargantuan demands of a dynamic private industry, the alarmingly inadequate supply of engineering educators—all these are factors in the outlook for civil engineering.

Noah D. Jackwood

President-elect, ASCE

Pittsburgh plans arterial high

JOSEPH BARNETT, M. ASCE

Assistant Deputy Commissioner, U. S. Bureau of Public Roads,

Department of Commerce, Washington, D.C.

Many and great are the difficulties involved in the development of arterial highways to improve vehicular transportation in a city. Unlike rural areas, where topography usually is the principal obstacle, a city is a complex and congested area teeming with activity. Except on the outskirts, all or most land is developed. The parts that make up the city—the central business district, surrounding neighborhoods, most residential areas, industries, civic and park areas, railroads, streets and highways—usually are well established and are decades old.

Despite this old established pattern, the highway engineer in planning and designing urban arterial routes is plagued with profound changes, both current and future. If he is fortunate there is a strong planning organization which can control land development so that he has a reasonable chance of predicting traffic needs, but in so many of our cities new development is uncontrolled, particularly in the suburbs where the rate of change is greatest. In these areas the highway engineer is the city planner, whether he wishes to be or not, for the arterial routes he develops become the backbone of the city plan, and land develops along them. This results in some semblance of an orderly plan, but without control of land use it is not satisfactory. Pittsburgh is fortunate in that it has had an area planning organization for some years, although it is a moot question whether the powers of this agency to control land development are adequate.

Many and rapid changes

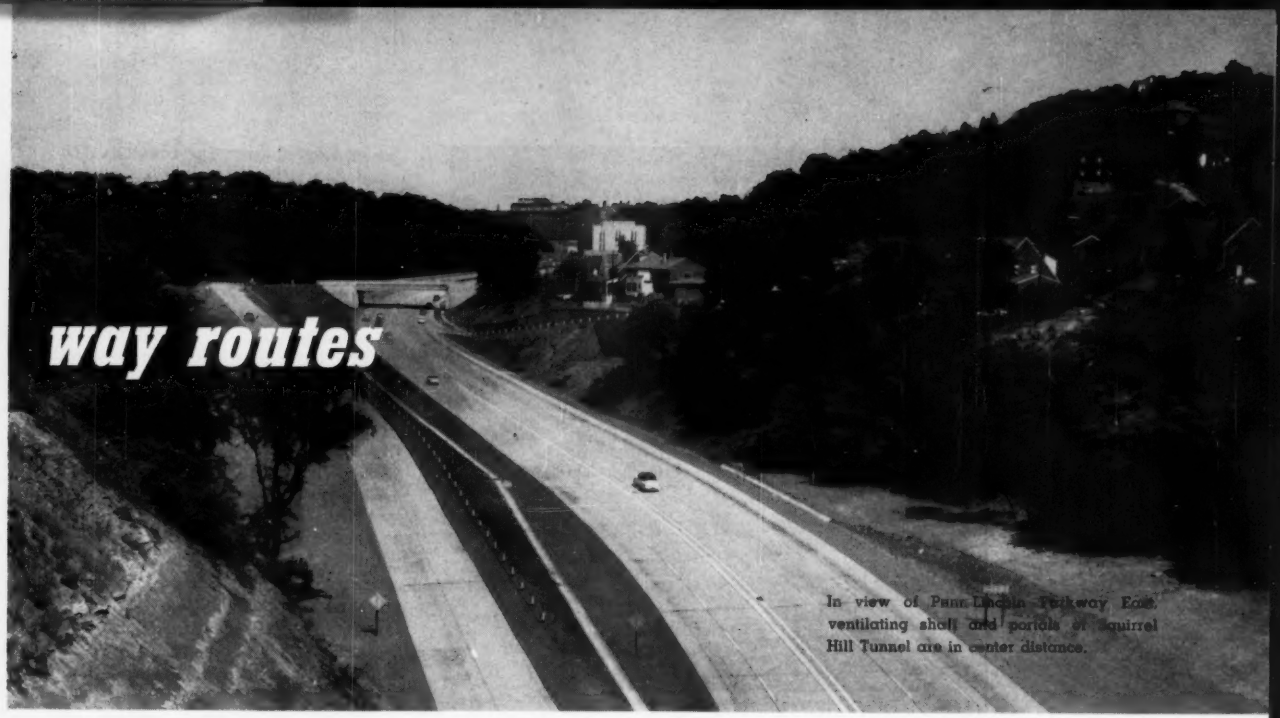
We have been witnessing very rapid changes in the outskirts of our cities. New housing developments, new shopping centers, and new distributing areas have sprung up almost overnight. Most of the workers living there work elsewhere—in the offices, shops, and factories of the cities. Most of these new areas depend entirely on motor vehicle transportation for getting their residents to work, for shopping, and for bringing in food, supplies, and other merchandise from established terminal, wholesale, and warehousing areas which are not readily moved to the suburbs. Since transportation consists of people—miles and ton-miles of people and goods respectively, the effect of the move to the suburbs is evident. Some movement of commerce and industry to the suburbs also has taken place but the favorable effect of this on congestion is small percentagewise.

Changes are also taking place within the cities. Parking lots are being replaced by buildings, further increasing the terminal problem, although the parking problem is being solved now that the driving public is getting used to paying reasonable fees for storage. These fees make it economically feasible to construct and operate parking facilities. The greatest effect on congestion is the replacement of old residences with office and light industrial buildings which increase the worker density. Most of these workers live in other city neighborhoods or suburbs and need transportation twice a day. This explains why predictions of volume by traffic engineers have been so outstripped on urban-suburban facilities. This need is being lessened by urban redevelopment housing which shortens the distance between home and work, possibly to walking distance—but only to a limited extent. In Pittsburgh, the Point redevelopment was first considered for apartment houses and that would have had a favorable effect on congestion in the Golden Triangle but other factors of greater importance changed it to the fine office buildings you see now.

The changes outlined have posed and will continue to pose problems for highway engineers but they are of a character affecting design rather than planning. Surprising to some, perhaps, is the fact that the pattern of arterial routes to satisfy the needs of motor vehicle transportation is not changing. The principal change is in the character, safety, and capacity of the highways comprising the pattern.

Traffic pattern takes shape

Numerous fact-finding agencies have brought many urban highway transportation problems into focus. As a result, it has become increasingly clear that much of the total traffic in a city is urban in character and that traffic con-



way routes

In view of Penn-Lincoln Parkway East, ventilating shaft and portals of Squirrel Hill Tunnel are in center distance.

gestion in cities will be solved to a great extent by the construction of facilities that permit the uninterrupted flow of traffic into and through the cities.

Numerous city plans of arterial routes show a remarkable sameness in the over-all pattern regardless of the special characteristics of the several cities. Adequate traffic data lead to the conclusion that, to serve traffic best, arterial routes should be located so that the through routes outside the city are connected with the central business district. Practical considerations, such as the high cost of property in the central area, require that the routes be located a little, perhaps several blocks, from the city centers. In most cities it is practicable to so locate these highways because the central business or commercial area is often surrounded by dilapidated old buildings, generally old residences, either converted to commercial use or allowed to run down into substandard housing. In locating an arterial highway in such an area, the cost of right-of-way is minimized, a divider between land areas of different character is established, and the land adjacent to the arterial route nearly always increases in value.

When the routes leading to the city are connected along these fringes of the central business district, the pattern takes shape. In the larger cities, it takes the form of a close-in circumferential or belt route from which arterial routes to the outskirts of the city, and beyond, radiate in several directions. The pattern may twist, bulge, or be cut off on one or more sides; the inner belt may be round, square, triangular, or elongated; the radial routes may be somewhat circuitous; and a large body of water or other topographic feature may block radial roads in some directions. Nevertheless, the pattern is evident.

In large metropolitan areas another characteristic part of the pattern is an outer belt, and sometimes an intermediate belt. These routes are useful and, in some cities, very necessary facilities for traffic between the outskirts or suburban areas and between points near different radial routes. They do not have first-order priority, however, although they are sometimes considered first because of the relative ease with which the right-of-way can be acquired.

In exceptional cases outer belts assume great importance. Route 128 in Massachusetts, for example, an outer belt for the city of Boston, is an expressway carrying 40,000 vehicles a day, but an analysis shows that, in addition to serving traffic bypassing Boston, it also is an arterial route connecting several of the 18 good-sized cities which surround the city of Boston. It is likely that an outer free-flowing belt around Pittsburgh would have the same function.

The pattern of arterial routes just outlined, even though modified by the circumstance of physical controls and available right-of-way, is close to ideal in many respects, fitting the needs of traffic as measured by many origin and destination surveys. Only a small fraction of the traffic approaching most large metropolitan areas has its destination beyond the cities themselves. But, of the accumulation of traffic approaching the central business district, a large percentage is destined beyond the central area.

Flexibility is important in developing a system of arterial routes—flexibility in choice of routes presented to a driver and flexibility in fitting future construction to future needs. When the central business district is surrounded by an inner belt, a driver has wide latitude in choice of routes. The individual driver does not have as his destination the central business district, or any other area, but a point in an area. He should be able to choose a route that will take him on a free-flowing facility as close to his point of destination as feasible. A flexible system of free-flowing arterial routes reduces the time of travel to a minimum, permits travel with ease and safety, and does not require travel on local streets any more than necessary, thus relieving congestion in the heart of the city where relief is needed most.

Three types of urban arterial routes

In planning arterial routes for a city, the type of arterial is important. The higher the free-flowing characteristics of a highway, the further that highway

FIG. 1. Arterial routes for a medium-sized city show typical pattern. Natural and man-made obstacles to freeway development are not nearly so great here as in Pittsburgh.

can be located from the center of the travel flow. There are three types of arterial city highways.

1. The major street is an arterial highway with intersections at grade and direct access to abutting property, and on which geometric design and traffic control measures are used to expedite the safe movement of through traffic.

Since legal or appreciable physical control of access is not likely, every opportunity is utilized to include some access control features. A raised median, for example, eliminates left-turn movements to and from private driveways, but some mid-block openings may be provided, as at alleys used for merchandise delivery and at entrances to park-and-shop businesses. Even with such openings, a median places other driveways under positive control for right turns only, with resulting benefit to through traffic. Some driveways are eliminated altogether by relocation to cross streets or alleys.

Existing cross streets seldom are terminated at major streets but some of the turning movements, particularly left turns, are avoided at some of them. Various forms of traffic control improvements are used to expedite through traffic, and one-way streets are employed to improve capacity and operation at intersections.

2. The expressway is a divided arterial highway with access controlled to varying degree and generally with grade separations at intersections. A significant distinction between a major street and an expressway is the distance between crossings and access connections. Whereas a major street may include numerous private driveways, an expressway has relatively few, if any. On a major street, connections

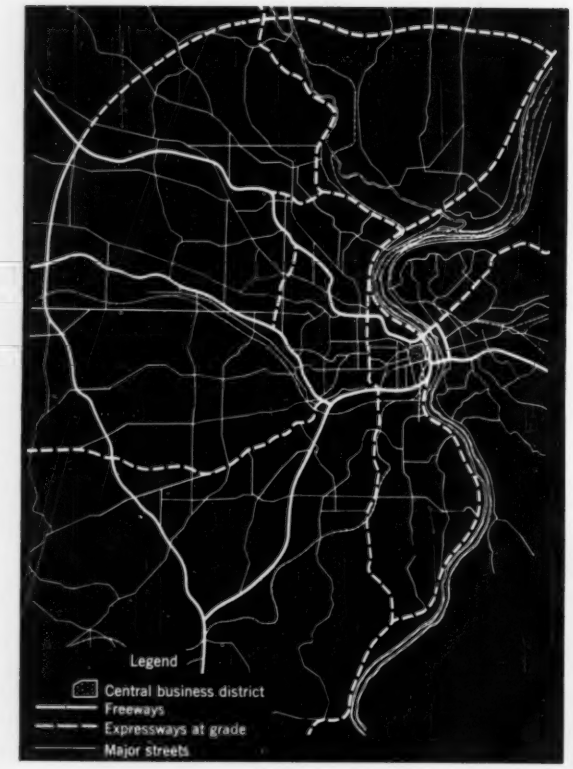


FIG. 2. Arterial routes for a large city show typical pattern.

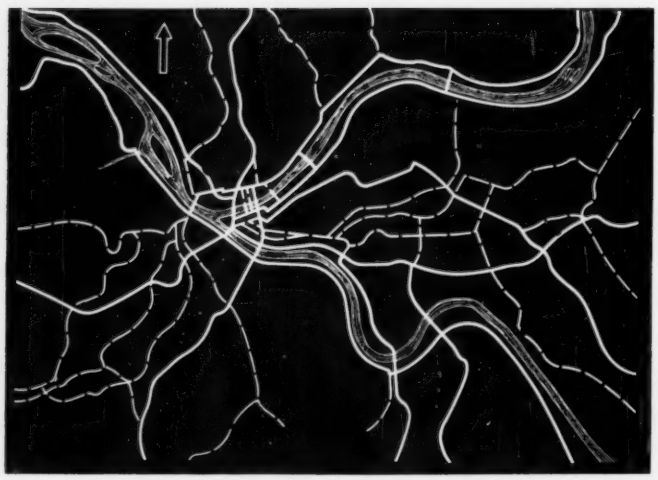


FIG. 3. Pattern of recommended primary arterial routes for Pittsburgh is given in diagrammatic form.

generally are made at each intersecting street, most of which cross the major street, but on an expressway some of the intersecting streets are terminated, either completely or with right turns only; a few might cross at grade, and some are separated in grade. A major street may not have a median, whereas opposing traffic on an expressway is separated by a median.

Sometimes a separate and parallel road—the frontage road—is provided for service to property and for connection between terminated streets and nearby crossroads and other access points. The frontage road may be part of the arterial highway—a design feature of physical access control brought about by terminating crossroads. Or the frontage road may be an existing street utilized as the outer portion of the arterial highway. Another design distinction between an expressway and a major street is that on the former some of the access connections are in the form of ramps at separated crossroads.

Expressways cover the wide range in facilities between the two extremes of major street and freeway. An expressway of the lowest order may be a facility entirely at grade but may include frontage roads and the access control features of terminated crossroads. Such a route is often called an expressway at grade.

3. The freeway is an expressway with control of access throughout and with no crossings at grades.

New routes needed

Existing arterial routes in cities, for the most part, are major streets and wholly inadequate for arterial traffic. On the average highway approaching a city, traffic volume increases but capacity drops as a result of narrowing streets, more frequent crossings, and increasingly greater volumes on the crossings. Furthermore, opportunities for widening become fewer as the central area is approached because of the increase in value of the land and of the structures on it.

It is clear then, and now generally accepted, that since existing arterial routes are not amenable to development to high capacity, new arterial routes are needed. Existing major streets are needed anyway both for local through movements and for access to the businesses located on them. It is also generally accepted that these new routes cannot be patterned on, or of the same type as, the existing routes. They must be free flowing and have control of access to lower the appalling accident rate and to retain their capacity and permanency, or the relatively high investments required for them would not be justified. The answer then is freeways.

In most cities the principal obstacles to the location of freeways are high cost, both in right-of-way and construction, and the opposition of owners whose property is taken and officials who deplore the taking of taxable property. These people are unable or unwilling to visualize the increase in the value of other property caused by free-flowing transportation. In Pittsburgh there are several additional obstacles. The central area is a triangle hemmed in by the Monongahela and Allegheny Rivers on two sides and a hill, or mountain perhaps, on the third side, and the areas outside the central triangle also present obstacles in the form of ridges and hills which make it extremely difficult to locate on direct high-speed alignments and to have reasonable gradients without excessive cuts and fills or long structures and tunnels. In Pittsburgh there also are the obstacles of the steel mills and allied industries, which with their established large areas and railroad services are not easily moved or pushed aside. I know of no section in the country where the combination of obstacles in the way of freeway development is so great or so concentrated as it is in the Pittsburgh area.

Progress in Pittsburgh

Pittsburgh has, however, made fair progress in the development of its arterial routes. Long before serious consideration was given to an expanded highway program, which culminated in the Highway Act of 1956, the State of Pennsylvania, the City of Pittsburgh, Allegheny County, and surrounding cities and counties were moving forward with the development of arterial routes in this area. Water Street, Duquesne Way, Bigelow Boulevard, and the Boulevard of the Allies are monuments to the bold thinking of the early planners and highway builders. The Liberty Tunnel and the many bridges across the rivers required leadership of the highest order.

Coming down to modern times, this city was fortunate in having three things—a fair highway plan, the Allegheny Conference on Community Development, and the Pittsburgh Regional Planning Association. Thus the planning efforts of state, city, and counties were coordinated, and the backing of the citizens obtained. Above all, this city was fortunate in having, during a most critical time, Mr. E. L. Schmidt as Division Engineer for the State Department of Highways. It was he who had that important combination of ingredients—the vision to see the need for freeways and the ability to loosen the purse strings. Without a practicable plan of financing, the best highway plan is still a paper plan. There followed the preparation of plans for the Penn-Lincoln Parkway East by Michael Baker Jr., and its later construction, and a willingness to tackle the seemingly insoluble problem of carrying the freeway west through the Golden Triangle.

There was one shortcoming of prior planning and freeway design and that was the lack of preliminary designs relating peak-hour traffic volumes to capacity. Mr. Schmidt requested assistance in this from the Bureau of Public Roads, which, under the writer's direction, made a preliminary design of the downtown interchange as a demonstration project. Subsequently the engineers of the Department of Highways and the George Richardson engineering organization made the preliminary analyses and followed with the splendid plans for carrying the Penn-Lincoln Parkway through the Golden Triangle, now under construction, and the proposed freeways to the west and north and elsewhere.

These bold designs, and the plans going forward for the two new bridges at the Point and the connections to them, fully match the vision of the citizens of Pittsburgh, which is so evident in the redevelopment of the Point area, the bold attack on the parking problem, the reduction of smog, and numerous other civic, private and cooperative ventures that are making Pittsburgh once more a pleasant place in which to live and work.

With the physical and other highway controls so severe in the Pittsburgh area, one would suppose that the pattern of arterial routes would be materially different from that experienced elsewhere or in other cities of comparable size, as previously described. In Figs. 1 and 2 appear patterns of arterials for cities in which the obstacles to freeway development are not nearly so great as in Pittsburgh, whose pattern of arterials is shown in Fig. 3.

The pattern for Pittsburgh is not so clear cut because of the winding alignment of the routes necessary to fit the severe topography. The inner belt is on the three sides of the triangle. The Water Street development along the Monongahela River, Duquesne Way along the Allegheny River, and a cross-town route between the two rivers, either on line with the Liberty Bridge, or farther east as it is being considered at this time, complete the inner belt. The principal radial routes are the Penn-Lincoln Parkway to the east, the Penn-Lincoln Parkway to the west, routes along the Allegheny, Manongahela, and Ohio Rivers, and a proposed new route to the north. An intermediate belt is not clearly defined but an outer belt which bypasses the city entirely is

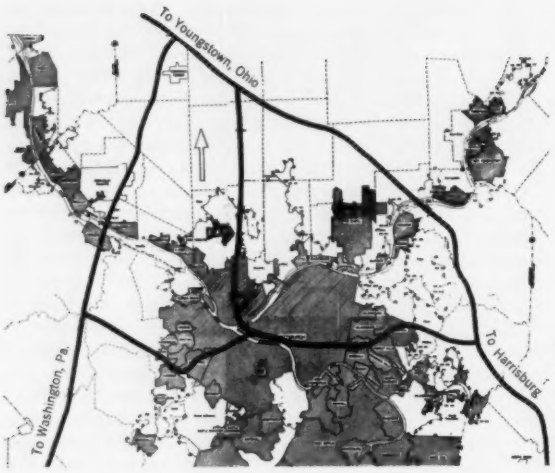


FIG. 4. Pattern of recommended Interstate Routes for Pittsburgh and vicinity gives general location only.

shown in the pattern of federal-aid interstate highways for this area, as shown in Fig. 4.

Generous federal allocations

The Congress, in passing the Highway Act of 1956, provided an opportunity for all areas to catch up on their highway needs. In addition to providing greater sums than ever before for the improvement of the federal-aid primary system in rural and urban areas, and the federal-aid secondary system and its extensions in urban areas, it made separate and liberal provisions for the National System of Interstate and Defense Highways. The allocations for the fiscal years ending June 30, 1957, and 1958, have already been apportioned among the states. For the interstate system alone, these allocations amounted to $1.175 billion for 1957 and $1.7 billion for 1958. The matching ratio, 50-50 on the traditional federal aid systems, was increased to 90 percent federal-aid and 10 percent funds under state control, except for the public-land states in the West, where the federal share is somewhat higher but never more than 95 percent.

Furthermore, the Congress has declared its intent to continue the allocations for the interstate system and increase them, reaching a peak of $2.2 billion annually, and to finance the completion of the system in a period of 13 years. Since these separate allocations will provide for the improvement of some of the most important routes in the country, it should be evident that the improvement of all other routes on the federal-aid systems will also be accelerated since normal state-federal financing will be relieved of the need for financing the interstate system.

The interstate system is a national integrated system limited in total length to 41,000 miles. With a little more than 1 percent of the total road mileage of the country, it is expected, when completed, to carry about 20 percent of the total vehicle-miles of travel. It is the most important national system for both commerce and defense.

The reasonable certainty of financing the improvement of the system to completion presents an opportunity for states, counties, and cities to do some realistic long-range planning and indulge in those efforts which highway engineers have advocated for so long—adequate traffic studies, preliminary planning and design, tying down the line and highway type, and above all, advance acquisition of right-of-way so that the wasteful practice of acquiring and destroying land improvements can be avoided. And this would be only the beginning, for with a fixed plan for, and certainty of, freeway improvements, private enterprise will be given the courage to develop the adjacent land areas properly.

The designated interstate system for the Pittsburgh area is shown in Fig. 4. The lines representing the system indicate general location only. The state has made engineering and economic studies for some routes and will make them for others to determine the location that serves the intended purpose, that is as direct as feasible, and that is amenable to improvement to the interstate standards adopted by the American Association of State Highway Officials and accepted by the Commissioner of Public Roads for use on federal-aid interstate projects. It is not within the province of this paper to discuss interstate standards. The reader is referred to the writer's article published in two parts in the July and August 1955 issues of CIVIL ENGINEERING. While some changes have been made in the standards there discussed, the article is still applicable.

The most important item in the interstate standards is that requiring access control. This is in line with the provisions of the Highway Act of 1956. Access control is fully discussed in the article mentioned above. It is gratifying to the writer that after a quarter of a century of effort, it no longer is necessary to sell access control. Its benefits, both in safety and in utility, have now been so well demonstrated that the demand for access control on all important arterial routes is becoming overwhelming. It is to the credit of officials in the Pittsburgh area that there has been no questioning of the necessity for access control for several years.

In closing, I plead for more consideration of one factor in the design of the interstate sytem—or for that matter of any highway—which may be neglected in the rush of getting the necessarily large sums of money obligated. I refer to the matter of appearance. A highway is a public facility and there is just as much justification for insuring that it be pleasing in appearance, that its structures be architecturally correct, and that the roadsides be properly landscaped, as there is in the case of any other public facility such as a public building.

A highway properly fitted into the landscape and designed as two one-way roadways, with a variable width of median and separate profiles, generally costs no more than one designed with a fixed cross section. Properly landscaped roadsides reduce erosion and are more easily maintained. As for the bridges, engineers of long experience know that a structure which looks right generally is right, and that pleasing line and form add nothing to the cost.

Private industry long ago learned the value of good public relations, and the office buildings, factories, and even heavy industrial plants constructed in recent decades are pleasing in appearance and well landscaped. We highway engineers should follow this example, for in the final analysis our highways will be judged not by the thickness of the pavement but by the safety and ease with which they can be driven over, and by what the motorist sees and feels while traversing them.

(This article is based on the paper to be presented by Mr. Barnett at the ASCE Annual Convention in Pittsburgh, before the joint session of the City Planning, Highway, and Structural Divisions, presided over by George S. Richardson, Director, ASCE.)

Many unusual structures feature Penn-Lincoln Parkway

CHARLES R. WAY, A.M. ASCE

Associate, Richardson, Gordon and Associates, Consulting Engineers, Pittsburgh Pa.

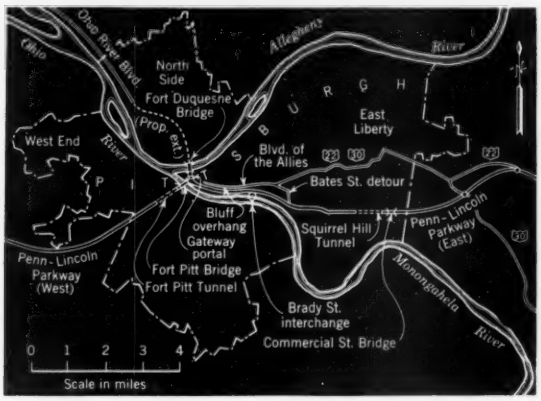


FIG. 1. Penn-Lincoln Parkway has length of 20 miles—about 10 miles in each direction from Pittsburgh's Point Park.

Thirty years ago, Pittsburgh's Penn-Lincoln Parkway was only a dream in the minds of a few who realized that what were then considered as modern highways would soon be obsolete. Taking its name from the William Penn Highway (U. S. Route 22) and the Lincoln Highway (U. S. Route 30), the Penn-Lincoln Parkway carries these two routes from a point about ten miles east of Pittsburgh to a point about ten miles west of it (Fig. 1). For this twenty-mile length the total cost has been estimated as in the neighborhood of $150,000,000. Much of this cost is in the numerous and varied structures required by the rugged topography, intensive land use, waterway requirements, and traffic needs of the Pittsburgh area. For the past ten years construction of these structures has been proceeding at an ever increasing rate.

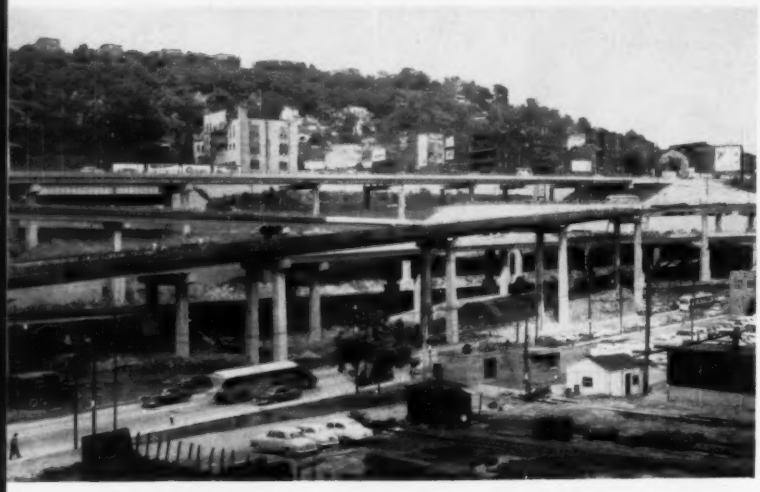
Today's motorists can drive on all but four miles of this expressway system, but those traveling on the highway will not be able to appreciate the varied collection of structures that make their trip possible because many of these structures carry the parkway itself. The most outstanding example is the $1,800,000 Commercial Street Bridge which carries the four-lane parkway over Nine-Mile Run and Frick Park just east of the 4,200-ft Squirrel Hill Tunnel. The overall length of this striking concrete arch structure is close to 860 ft. Its three main arches span 170 ft between spring lines and rise to a height of over 90 ft above the valley floor.

West of Commercial Street and some two miles west of the Squirrel Hill Tunnel, the parkway is abruptly detoured by way of Bates Street into the overcrowded Boulevard of the Allies. From this detour point for some three miles the parkway parallels the Monongahela River to the Point area of Pittsburgh, where the Allegheny River joins the Monongahela to become the Ohio. Near the Point the Penn-Lincoln Parkway East ends and the Parkway West begins. At the Point itself the parkway will cross the Monongahela River on a new structure, the Fort Pitt Bridge, and thence will run under Duquesne Heights through the Fort Pitt Tunnel to complete the link with the Penn-Lincoln Parkway West, already completed.

The three miles from just west of the Bates Street Detour to and including the Point Bridge across the Monongahela River is the part of the parkway known as the Downtown Interchange and the Point Interchange. Construction costs for this section alone are estimated at close to $50,000,000. For this partially constructed section many unusual structures have been designed.

Proceeding west from the Bates Street Detour on our mythical ride over the most complicated section of the parkway from the design standpoint, the Brady Street Interchange is quickly encountered. Here the highway designer has done an excellent layout job. By utilizing most efficiently the narrow available space and providing the minimum of ramps, this interchange provides simple, direct connections to and from the parkway with only one ramp on any appreciable curve. At one point in the narrow width of 300 ft there are nine separate roadways at various levels, plus a two-track railroad. For the

Most outstanding of existing bridges on Penn-Lincoln Parkway East is $1,800,000 Commercial Street Bridge. This striking concrete-arch structure is 860 ft long, carries four-lane parkway over Nine-Mile Run and Frick Park just east of Squirrel Hill Tunnel.



One of most complicated structures on Penn-Lincoln Parkway East is Brady Street Interchange. At one point in its narrow width of 300 ft, there are nine separate roadways at various levels, plus a two-track railroad. Here construction proceeds on Ramp V, in foreground.

Where Boulevard of the Allies skirts bluff, it has been widened about 10 ft by eliminating sidewalk and extending roadway on T-headed concrete piers set into face of bluff and cantilevered out 4 ft 6 in. Piers vary in height from about 15 to 40 ft. High-strength precast concrete beams span distance of nearly 28 ft between piers.

structural designer these direct connections meant flat skews and a multitude of design problems. These flat skews and tight clearance requirements have dictated the use of several beam-and-girder structures of long span.

One ramp of the Brady Street Interchange, known as Ramp V, is supported on a structure for more than 1,200 ft of its length. This structure includes six wide-flange beam spans, each 115 ft in length. These long spans, supported by 36-in. rolled wide-flange stringers at normal transverse spacing, were made possible by adopting a tandem cantilever design consisting of a 99-ft span and a 16-ft cantilever. This principle was utilized further in this ramp for a 126-ft span by using a 5-ft plate girder with a cantilever at each end of $18^1/_2$ and $31^1/_2$ ft to connect respectively a 99-ft beam span and a 150-ft girder span.

These long-span structures of relatively shallow depth are quite pleasing in appearance when completed. However, before the decks were paved, these ramps had a weird undulating appearance due to the dead-load camber. Some special studies of this ramp were made to determine the approximate value of the maximum dynamic deflection caused by a moving load. These studies indicated that the maximum dynamic deflections were up to 30 percent greater than the static deflection, but were still well within the limits of the specifications.

Most of the span arrangements for the Brady Street Interchange were dictated by the space limitations. Little opportunity for repetition was provided. The substructure design, complicated as it was by flat ramp crossings and by limited horizontal and vertical clearances, was further complicated by city streets and by utilities and drainage lines. This resulted in numerous combinations of concrete and steel rigid frames, concrete pedestals with various simple and cantilevered box-girder crossbeams, and framed steel and concrete bents.

West of the Brady Street Interchange, the parkway continues between the Monongahela River and a high bluff supporting the Boulevard of the Allies. Constructed shortly after World War I, this four-lane boulevard was at the time the latest in highway design. Today its curbed four 9-ft lanes along the bluff overlooking the Monongahela River are grossly inadequate for present-day traffic. As originally constructed, the boulevard skirted the top of the 140-ft-high bluff and at several locations the sidewalk overhung the bluff.

The boulevard serves a very important need in carrying local traffic to and from downtown Pittsburgh besides serving as a feeder for the much needed Crosstown

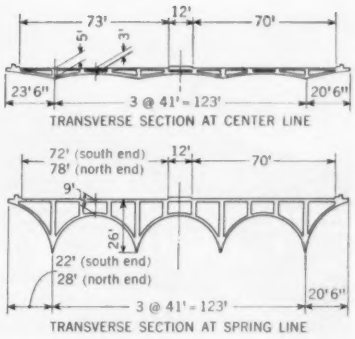
Boulevard. Accordingly the alignment has been corrected as required and the roadway will be widened by 10 ft on the bluff side to a total width of 46 ft 8 in. This widening will still not bring the Boulevard of the Allies up to present-day standards for a four-lane thoroughfare. However, further widening would be very costly.

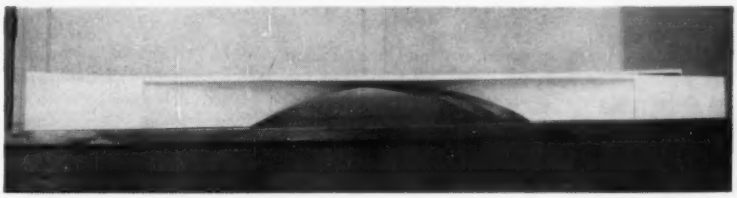
In the western part, where the widened section overhangs the bluff, and where precast high-strength concrete beams support the roadway for a distance of 336 ft, the sidewalk has been eliminated. The precast beams are channel shaped, with their backs serving as the base for a 3-in. bituminous surface course. The interior beams are 4 ft in width and 2 ft 1 in. in depth, with a length of just under 28 ft. Each weighs almost 11 tons. The leg thickness averages 11 in. with a 6-in. connecting slab. The beams were designed as modified T-beams utilizing 5,000-psi concrete. Eight No. 11 bars, four in each leg of the channel, are the main reinforcement for the interior beams. If these same beams were to be designed today, more consideration undoubtedly would be given to the use of a prestressed design. Beams of this design speed construction and practically eliminate future maintenance. The uneven face of the bluff was easily fitted by varying the number of beams. A minimum of three beams and a maximum of five were used in the twelve 28-ft spans as required by the uneven bluff and the quality of the rock. The beams rest on solid concrete piers, each of which is cantilevered out 4 ft 6 in. The T-headed piers were poured in slots cut in the bluff to a width of 3 ft and were stepped from the base up as required by the profile of the rock. They vary in height from 15 ft to just over 40 ft.

On its eastern end the boulevard also will be widened in the near future by eliminating the sidewalk and cantilevering the roadway over the bluff. Within a distance of over 700 ft, the boulevard will overhang from 3 ft 3 in. to 10 ft 6 in., including the 3-ft 3-in. combination of safety walk and parapet. Existing stone or concrete walls which face the bluff will be used as the bearing points for the cantilevers. Where needed, new concrete facing walls will be constructed to provide this support. The roadway slab itself will become a reinforced concrete slab with sufficient weight to counterbalance the loaded cantilever. In the case of the 10-ft 6-in. cantilever, the roadway slab will be 6 ft in depth for a 5-ft width near the roadway centerline to act as a counterweight.

If now we return to the Penn-Lincoln Parkway East, and proceed down river, we will find that the parkway threads its way over, under, or around four main river bridges, city streets, railroad freight yards, and terminal facilities to the Point area of Pittsburgh, where the Penn-Lincoln Parkway East ends and the Penn-Lincoln Parkway West begins.

FIG. 2. Reinforced concrete arch known as Gateway Portal will span Pittsburgh's Point Park and connect vital traffic arteries which cross at this strategic location. In figure, transverse sections indicate complicated geometric problems created by architectural treatment of under side of this massive structure, which consists of a series of three interior bays formed by circular arcs and two exterior half bays formed of compounded circular arcs. Photograph below shows 1:64 model made to aid design and geometric calculations.





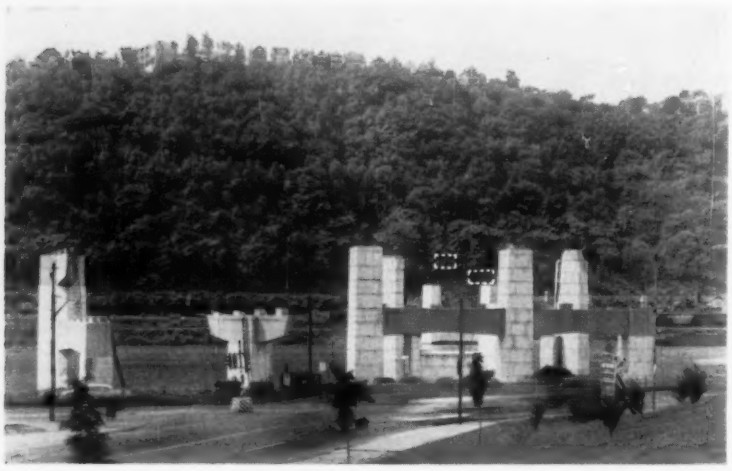
At present there are two structures at the Point, the Point Bridge spanning the Monongahela River and the Manchester Bridge spanning the Allegheny River. Constructed in 1926 and 1914 respectively, these structures are much too close to the actual confluence of the rivers to permit the proper interchange of the traffic using them. Accordingly new structures will be built across each river approximately 1,000 ft upstream from the Point to allow room for a workable traffic interchange. This rearrangement will accomplish another purpose in that a considerable area will be cleared of roadways and structures for development of the Point State Park by the Department of Forests and Waters of the Commonwealth of Pennsylvania to perpetuate the historical significance of the Point area as the gateway to the West.

Traffic going to and from the two new bridges—or merely around the Point area—will be funneled across an unusual structure, known as the Gateway Portal. It will permit access to the Point itself by means of a pedestrian bridge spanning a man-made pool under the portal structure. This unusual structure will be almost as wide as it is long. It will span 170 ft between spring lines with a vertical rise of 22 ft at the center of the span. Between curbs each roadway will have a minimum width of 70 ft and the two roadways will be separated by a 12-ft median strip. The structure is located at the focal point of the main ramps at the Point, and its extreme width is required to allow traffic to weave on to adjacent ramps.

In keeping with the natural beauty of the Point Park, this single-span structure will be a reinforced concrete arch. The architectural treatment of its under side will present many design and construction problems. A transverse section through the center of the arch shows a series of four cusps on 41-ft centers varying in depth from 3 ft at the midpoint between the cusps to 5 ft at the point of each cusp (Fig. 2). The under side is thus a series of three interior bays formed by circular arcs and two exterior half bays formed of compounded circular arcs. Similarly, at the spring line, on the same centers, the depth varies from 9 ft at the midpoint between the cusps to 26 ft at each cusp. Cellular construction will be utilized to reduce the great dead load. About 60 ft beyond the spring line the exterior bays will be warped into a vertical retaining wall in a manner similar to the warping of a ship's hull. The geometry is further complicated by the horizontal curvature of the ramps on one side of the structure. The design and geometry of this structure as well as its construction will be difficult, but when completed it should be attractive.

Perhaps the most unique structure of the entire Penn-Lincoln system is the bridge across the Monongahela River, known as the Fort Pitt Bridge, now under construction. This structure will be a tied arch of 750-ft span carrying four lanes of traffic in each direction on

Probably most unusual structure on Penn-Lincoln Parkway will be Fort Pitt Bridge crossing Monongahela River near the Point. Granite-faced approach substructure and main piers are already in place as shown in view below, in which dashed rectangles indicate approximate location of portals for Fort Pitt Tunnel, now in design stage. On far side of river, Canon Street Interchange is under construction. When completed in 1958, bridge will be only known double-deck tied arch as well as only known arch tied by a truss (see artist's sketch above). In both views, Point Park is in foreground and Point is to right.



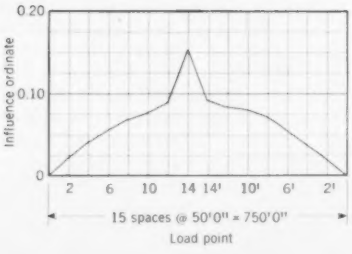


FIG. 3. Influence line for Hanger 14 of Fort Pitt Bridge shows abrupt peak between panel points 12 and 14. This characteristic, typical of all hangers on this bridge, was confirmed by testing 1:100 scale model.

two different levels. When completed, it will be the only known double-deck tied-arch bridge in existence. It is also the only known arch tied by means of a truss.

In the near future a similar structure of 425-ft span will bridge the Allegheny River at the Point, not as a part of the Penn-Lincoln Parkway, but as a part of the program of the Pennsylvania Department of Highways for the relocation of State Route 88, the Ohio River Boulevard. This structure will be known as the Fort Duquesne Bridge.

Going back to the design of the Fort Pitt Bridge, space for approach ramps dictated the use of a single-span structure. A truss span, although near the extreme limit for such a design, would have been possible, but its appearance would have been awkward and not in keeping with the developments in the Point area. A tied arch was selected because of its practicability and good appearance.

This structure was first analyzed as indeterminate in the first degree, assuming that the arch rib would take no bending moment. The final design was based on the analysis of a structure indeterminate to the 15th degree, the unknowns being the 14 hanger stresses and the arch thrust.

In the solving of these unknowns, an electronic computer was utilized to solve 14 sets of 15 simultaneous equations. The card programming for this particular phase required about one week of time for one man, but the mechanical solution itself was reached in two hours. The same electronic computer was found invaluable for numerous other calculations for this arch structure.

The influence lines for hanger stresses are curved except between the hangers immediately adjacent to the hanger in question. For these two panels the influence line abruptly seeks a peak at the hanger itself (Fig. 3). This unexpected behavior was investigated thoroughly and is believed to be correct. As a check on the theoretical solution of this arch, a 1:100 scale model was constructed, loaded, and tested at the Thayer School of Engineering of Dartmouth College. The model test supported the theoretical study to a very satisfactory degree.

Substructure construction for the Fort Pitt Bridge is now complete. Founded on rock some 50 ft below the normal pool level, the granite-faced piers rise 40 to 60 ft above the murky Monongahela River, awaiting the superstructure. Superstructure construction is expected to begin in the late spring of 1957. When completed, this structure will contain over 8,000 tons of steel, two thirds of which will be high-strength.

The Penn-Lincoln Parkway of the Pennsylvania Department of Highways includes many other unique and unusual structures which have challenged the ability and ingenuity of the design engineers in their efforts to create a superhighway which will best meet the needs of the Pittsburgh area. The present urgent highway needs of our urban areas will necessitate many more such structures and will provide fascinating planning, design, and construction problems for the engineers of the future.

(This article has been prepared from the paper which will be presented by Mr. Way at the ASCE Annual Convention in Pittsburgh, before the joint session of the City Planning, Highway, and Structural Divisions, presided over by ASCE Director George S. Richardson.)

Sludge digestion can be improved

PAUL J. CERNY, Sales Engineer, Eastern Sanitary Division, Dorr-Oliver Inc., Stamford, Conn.

Mark Twain once said, "Everybody talks about the weather but nobody does anything about it." Until five or six years ago, the same could have been said about sludge digestion. True, a great deal was learned about the biochemistry involved and several improvements were accomplished which resulted in better control of the environment within the tanks. However, these improvements were barely sufficient to hold the line in the face of an increasingly difficult raw product resulting in part from the introduction of garbage grinding and the comminution of screenings.

During this period, the conferences held and the literature written on sludge digestion were enlivened by arguments on such subjects as the value of liming, methods of scum control, series versus parallel operation of multiple units, methods of supernatant withdrawal, and the effect of supernatant on various treatment processes.

Requirements for heated digestion capacity as established by some state health departments for various types of sewage treatment actually have increased over the past twenty-five years. Why? During a period when sedimentation tanks were reduced in size by 50 percent, trickling filters by 80 percent, aeration tanks by 50 percent, and sludge dewatering facilities by 50 percent, and when other significant improvements and economies were effected in the facilities for handling grit and screenings, no real progress was made in sludge digestion. One assumption is that the general approach was wrong. Instead of seeking an overall solution, attention was focused on repairing each link as it failed!

All in the sanitary engineering profession have a strong interest in sludge digestion and many have had experiences strikingly similar. How frequently does a structure, designed and equipped as a digester, turn out to be a combination unit providing immense storage capacity for scum, silt, dead sludge, and dirty water? Within this, a small heart works frantically as a high-rate digester and does an excellent job of it.

In the past five of six years several independent investigators have done work in this field. (See articles by Wilbur N. Torpey, M. ASCE, in *Sewage and Industrial Wastes*, April 1954 and Feb. 1955; by C. N. Sawyer and H. K. Roy, ibid, Dec. 1955; and by Philip F. Morgan, M. ASCE, ibid, April 1954.) In the light of these developments, there is no reason why this "heart" cannot be isolated, thereby materially and safely reducing capacity requirements. This can be expedited by more precise definition of the controlling factors in the regulations of state health departments, and it can be done progressively as experience warrants. To develop this thesis conclusively, a certain amount of general review is necessary but details can be dispensed with since all the significant work has been adequately reported in the literature by the aforementioned investigators and is readily available for reference.

All investigators generally accept the time-proved rules for good digestion shown in the box on this page. It would seem axiomatic that a digestion system providing facilities and controls for utilizing all seven factors to the highest degree would be most efficient and economical. However, there are involved interrelationships which must be evaluated before any particular system can be analyzed.

In most plants sludge is transferred directly from the sedimentation tanks to the digesters. In all except extremely large plants, such transfer must be made intermittently to allow some concentration to take place. On the other hand, the deep sludge blankets required for concentration cannot be tolerated in the sedimentation tanks without weakening the clarification or oxidation processes. Obviously, this method of sludge transfer is a compromise at best and adversely affects the water content of the raw sludge and the feed rate to the digesters, as well as the quality and quantity of the supernatant liquor. Also, since the total amount of available alkalinity is a constant, the alkalinity concentration is inversely proportional to the water content of the raw sludge.

Efficient mixing of the entire tank contents is necessary not only for the prevention of temperature and solids stratification but also for effective intermingling of new feed with active sludge in all parts of the tank. Where mixing is inadequate, digestion rates in the different zones will vary from near zero—in the dry scum mass at the top and in the inert sludge and silt mass at the bottom—to the maximum at some level between these extremes. Some attempts have been made to evaluate the degree to which digester volume is utilized with various types of mixing but no sufficiently satisfactory correlation has been arrived at.

Requirements for good sludge digestion

1. Continuous or frequent incremental feeding of raw sludge.
2. Elimination of unnecessary water with raw-sludge feed.
3. Pre-seeding of raw-sludge feed with actively digesting material.
4. Maintenance of a uniform temperature within a range of 90 to 95 deg F.
5. Mixing of tank contents to utilize a maximum of the tank volume.
6. Maintenance of high alkalinity and low volatile acids.
7. Production of a supernatant of good quality, amenable to retreatment.

TABLE I. Analyses of samples—temperature, deg F

Depth, ft	Sampling Points 1	2	3	4	5
Without Mixing					
1	66	..	65	62	66
7	85	90	91	88	92
13	86	90	88	87	90
19	89	90	90	88	90
25	88	91	90	89	91
31	..	87	..	..	..
With Mixing					
1	..	..	..	..	..
7	92	89	90	90	92
13	91	90	89	88	91
19	92	90	91	89	91
25	90	92	91	88	93
31	..	92	..	..	..

TABLE II. Analyses of samples—alkalinity, ppm

Depth, ft	Sampling Points 1	2	3	4	5
Without Mixing					
1	...	...	...	...	...
7	1000	860	860	880	1000
13	1010	1050	945	900	970
19	1010	870	910	920	1020
25	3200	930	1060	1200	1210
31	...	910	...	...	...
With Mixing					
1	...	...	...	...	...
7	900	910	950	1030	1090
13	1080	940	930	1070	950
19	860	940	910	920	1040
25	1620	1070	900	1100	1120
31	...	1590	...	...	...

TABLE III. Analyses of samples—pH

Depth, ft	Sampling Points 1	2	3	4	5
Without Mixing					
1	6.9	...	7.2	...	...
7	6.9	6.8	6.5	6.7	6.5
13	6.7	6.8	6.9	6.7	6.6
19	6.8	6.9	6.8	6.8	6.7
25	6.9	6.9	6.7	6.7	6.7
31	...	6.8	...	...	...
With Mixing					
1	...	...	...	...	...
7	6.6	6.4	6.7	6.7	6.7
13	6.5	6.5	6.8	6.7	6.7
19	6.6	6.5	7.0	6.8	6.7
25	6.7	6.7	6.8	6.6	6.7
31	...	6.6	...	...	...

TABLE IV. Analyses of samples—volatile solids, percent

Depth, ft	Sampling Points 1	2	3	4	5	Avg.
Without Mixing						
1	70	87	79	67	69	..
7	65	71	..	65	63	66
13	66	66	70	66	68	67
19	65	65	64	65	67	65
25	42	67	64	65	66	61
31	..	65	..	..	..	..
With Mixing						
1	..	..	..	..	..	..
7	67	74	68	69	68.5	69
13	67	73	72	68.5	65.5	69
19	66	71	67	68	68.5	68
25	52	70	67	72	63	63
31	..	69	..	..	..	..

TABLE V. Analyses of samples—total solids, percent

Depth, ft	Sampling Points 1	2	3	4	5	Avg.
Without Mixing						
1	25.9	23.7	31.6	24.5	26.4	26.5
7	0.8	0.7	0.6	1.8	2.1	1.2
13	3.1	2.1	2.0	2.3	2.8	2.5
19	5.2	3.7	2.9	3.8	4.2	3.9
25	14.6	4.5	6.8	6.3	7.3	7.9
31	...	6.0	...	...	...	...
With Mixing						
1	...	...	...	...	...	...
7	2.5	4.2	2.8	3.4	3.3	3.3
13	2.8	3.7	2.8	3.4	3.0	3.2
19	2.8	3.2	2.8	3.2	3.0	3.0
25	9.7	5.1	2.8	5.3	5.7	5.2
31	...	10.7	...	...	...	...

Effect of mixing sludge evaluated

During the week of April 17, 1955, one of the digesters at the Bucklin Point Sewage Treatment Plant at East Providence, R.I., was used to study the effect of mixing on solids distribution. The test digester—having a diameter of 75 ft and a side water depth of 27 ft 6 in.—has a column-supported cover of flat-slab concrete and is equipped with three draft-tube mixers of $7\frac{1}{2}$ hp. Sludge is circulated through a spiral heat exchanger to maintain proper digester temperature. Sludge pumped to the digester originates from a sewage flow containing about 40 percent textile wastes.

For two weeks before the first set of samples was collected, the mixers were not operated, except for the one into which the raw sludge was pumped. This mixer was operated only during periods of raw-sludge pumping in order to keep the draft tube clear. The first set of samples was collected after this two-week period of no mixing. The second set of samples was collected after 46 hours of continuous mixing. Sludge-depth samples were taken at 6-ft intervals at 5 different locations on the digester cover as shown in Fig. 1.

Since the draft-tube mixers had been operated only a few minutes a day for several months preceding the tests, 3 ft of scum had collected on the surface of the digester before the first set of samples was collected (Fig. 2, *b*). After 46 hours of continuous mixing, some scum at the exterior sampling points remained, but it had been broken around the mixers as observed through the hand-holes on the mixer plates (Fig. 2, *a*). Considering the extent of the initial scum formation, it was not expected that the mixers would eliminate it over the entire surface of the tank in 46 hours but, because of local conditions, it was not possible to delay the collection of the second set of samples beyond

this time. Therefore, in analyzing the results, all the data collected at the 1-ft depth have been disregarded.

Results of analyses of all samples for temperature, alkalinity, pH, volatile solids, and total solids are tabulated in Tables I to V inclusive. Note that variations in temperature, alkalinity and pH are relatively insignificant either with or without mixing except in the cold scum zone. The low values for alkalinity and pH are due to the high percentage of industrial waste present in the sewage flow into the plant. The distribution of volatile solids indicates a slight decrease with depth and a fairly uniform distribution with and without mixing except for the expected higher values in the scum zone. The distribution of total solids with and without mixing, as recorded in Table V and illustrated in Fig. 3, definitely shows a higher degree of uniformity and an increase in the solids content within the active zone when the draft-tube mixers are in operation.

The isosolids diagrams in Fig. 2 show the solids concentration levels in percentages of total solids through Section A-A of the test digester, with and without mixing. It is seen that under conditions of no mixing a definite lineal stratification occurs throughout. With mixing, the stratification occurs only below the draft tubes at the 21-ft depth, while a nearly uniform mixture is maintained in the mixing zone. Since the chief concern is with complete mixing between the water level and the draft-tube discharge ports, the results may be compared as they relate to this zone. If the solids in this zone were uniformly distributed the unmixed tank would have an average total solids concentration of 2.6 percent as compared with 3.2 percent after mixing, the increase being due to the action of the mixers on the top scum layer and the inert sludge mass below the draft-tube discharge ports.

If it is assumed that, under conditions of complete mixing, uniform mixtures having the above percentages of total solids would occur, the difference in uniformity can be compared. This comparison is shown in Fig. 4 and gives a deviation from these averages ranging from approximately minus 54 percent to plus 100 percent without mixing, and from approximately minus 6 percent to plus 3 percent with mixing.

It is emphasized that this report is not intended as an evaluation of the utilization of digester volume, but only as an evaluation of the effect of mixing on the distribution of total solids. Further studies are contemplated to determine the effect of mixing on volume utilization. These studies will cover a period of several tank displacements, and will be carried out in a digester

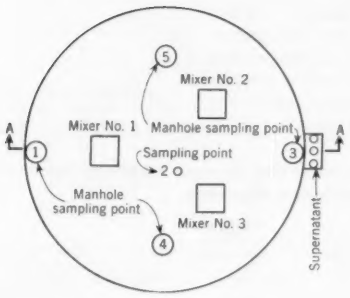
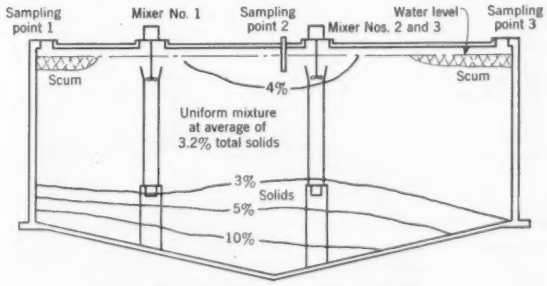
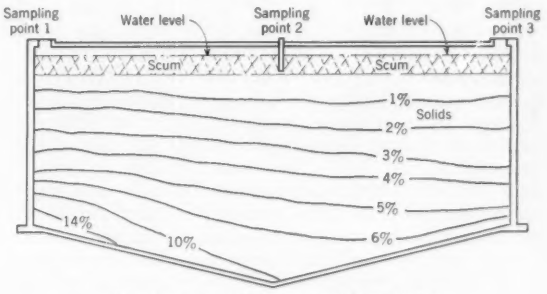


FIG. 1. Test digester is shown in plan.

FIG. 2. Sections A-A from Fig. 1 show solids concentration at various depths in test digester with and without mixing.

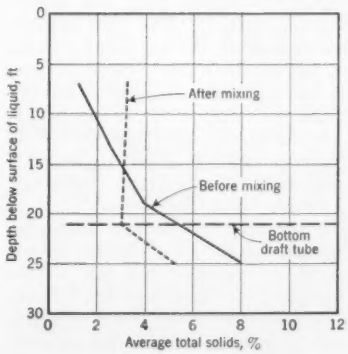


(a) PROFILE SECTION A-A, WITH MIXING



(b) PROFILE SECTION A-A, WITHOUT MIXING

FIG. 3. Solids concentration, before and after mixing, is plotted against depth below surface of liquid in test digester.



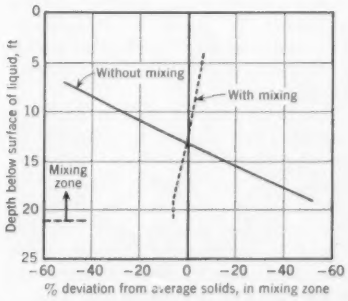


FIG. 4. Percentage of deviation from average solids concentration in mixing zone, before and after mixing, is plotted against depth below surface of liquid in test digester.

TABLE VI. Recommended design loadings for Densludge digesters

Type of Treatment	Sludge Concentration, % solids	Recommended Loading, cu ft per capita	Solids, lb per cu ft per month	% of Conventional Design
Plain sedimentation	12	1/3	9.0	23
Biofiltration	8	2/3	7.2	22
Standard filters	7	5/6	6.2	28
Activated sludge	5	1 1/3	4.3	33
Modified aeration with primary clarifiers	10	1/2	9.0	25
Modified aeration without primary clarifiers	8	2/3	6.7	33

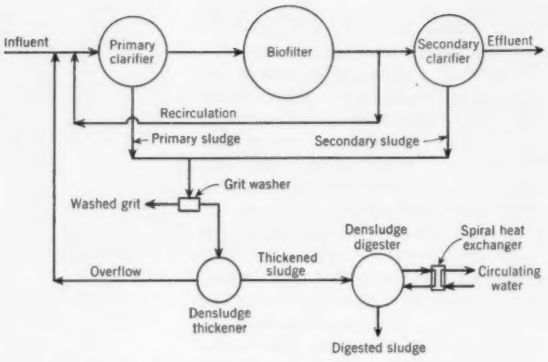


FIG. 5. Flow sheet shows recommended arrangement for Biofiltration followed by Densludge digestion system.

with the draft-tube mixers discharging through base elbows at the tank floor in order to extend the mixing zone to include the entire depth.

Sludge digestion system developed

A new digestion system has been developed to incorporate all the desirable and necessary features for accelerated digestion and at the same time to divorce digestion from the liquid processing portions of the plant. Figure 5 shows a typical flow sheet for a Biofiltration plant. Dilute underflow is continually pumped from the primary and secondary clarifiers and discharged to a grit washer. The grit-free overflow thence flows by gravity to the feed well of the thickener. The thickener overflow, comparable to raw sewage in B.O.D. and solids concentration, is returned to the raw-sewage flow for retreatment. Thickener underflow is pumped to the digester; further separation of liquid is unnecessary. Digested sludge is displaced to storage to be disposed of by any of the conventional methods.

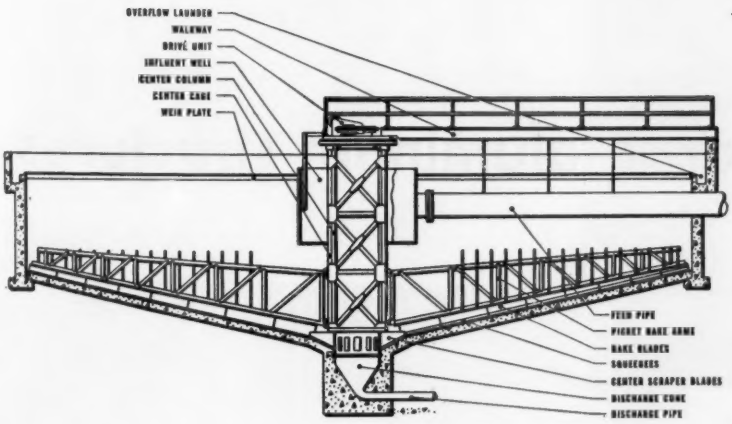
Many benefits not directly related to digestion are obtained by operation according to this flow sheet. By interposing the grit washing facilities between the clarifiers and the thickener, the need for separate grit collecting tanks is eliminated. Clarifier operation is enhanced by removing the settled solids as rapidly as they accumulate.

The cross-section of the thickener, in Fig. 6, shows the several necessary features to assure smooth and controlled operation. Feed is introduced through a radial pipe into a circular feed well at the center, and overflow is at the tank periphery. The slope of the tank floor is greater than normal to produce a deeper sludge blanket over the specially designed discharge port to expedite removal of thick underflow. Mounted on the arms are vertical members, or pickets, to gently stir the solids and release entrapped water. Steel pipe is used for all structural members of the rake arms to eliminate flat surfaces on which solids could deposit and putrefy. On units of 30-ft diameter and larger, the rake arms are hinged at the center cage, enabling them to rise automatically should they encounter excessive deposits. As the load is reduced by continuous raking, the arms automatically fall until they reach normal operating position. This makes it virtually impossible to stall or damage the machine by excessive loading.

The digester shown in Fig. 7 has been specifically developed to meet the requirements of this new sludge-digestion system. Essentially, this digester consists of a cylindrical tank with an anchored steel dome cover and sloping bottom, equipped with high-capacity mixers located 120 deg apart. Mixer propellers extend into open draft tubes located below the sludge level and terminating at the bottom of the tank in base elbows with the center lines of the discharge openings at 45 deg with the tank radii. In operation, sludge and scum are drawn into the draft tubes by the propeller action and discharged through the elbows at the bottom, imparting a combined swirl and vertical motion to the tank contents. Draft-tube mixers can be supplied in capacities from 2,400 to 22,000 gpm per unit, and sufficient capacity is provided to pump the equivalent of the volume of the tank in approximately 40 minutes.

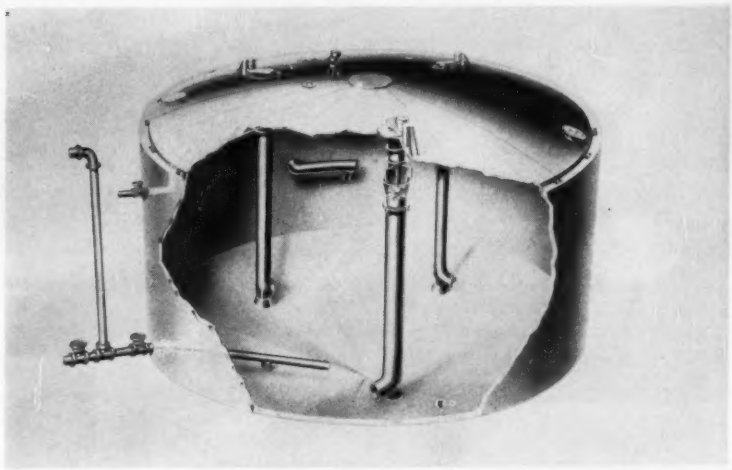
Recommended design loadings are shown in Table VI. At first glance these loadings seem quite radical because of the inclusion of figures for "Recommended Loading in Cubic Feet per Capita" and "Percentage of Conventional Design." Closer examination and analysis, however, reveal that they are quite conservative when compared to similar data in published reports of investigations of high-rate digestion. They are based on an average detention of 22 days, which corresponds to similar detentions currently used in conventional low-efficiency primary digesters in two-stage installations. The reductions in capacity result entirely from the reduced volume of sludge due to the proven prethickening step. No allowance is made for the increase in digester displacement efficiency with high-capacity mixing. Further, these recommendations on capacity do not include any allowance for the storage of digester sludge or gas. Since no supernatant need be withdrawn from the storage tank and since further thickening is not practicable, the storage tank can be of the simplest construction that will meet the requirements for sludge disposal and gas utilization of the particular installation.

Unquestionably there is need for additional investigation to more closely define the limits of some of the factors involved as regards their application to sewage treatment in general. For instance, the characteristics of thickened combined primary and secondary sludges



← FIG. 6. In sludge thickener, seen in cross section, feed is introduced into center well, and overflow is at tank periphery. Mounted on arms of this Dorr Densludge thickener are vertical members which gently stir solids and release entrapped water.

FIG. 7. Digester developed to meet needs of this new sludge-digestion system is equipped with high-capacity mixers. Sludge and scum are drawn into draft tubes by mixer propellers in tops of tubes, and are discharged through elbows at bottoms of tubes. Capacities of draft-tube mixer for this Dorr Densludge digester range from 2,400 to 22,000 gpm per unit. ↓



have been well established, and practicable thickener loadings produce a predictable underflow which offers no problems in handling or processing. On the other hand, further work with primary sludge alone is necessary to limit the concentration and so avoid pumping difficulties. This work is now in progress. It involves studies on thickener loadings and suitable piping and pumping arrangements.

Hindsight is always better than foresight—but it is revealing to learn how the latter understandably untrustworthy viewpoint is so often complicated by a sort of mass myopia. In 1947 when R. S. Rankin, M. ASCE, discussed "Digester Capacity Requirements" (*Sewage Works Journal*, May 1948), he departed from generally accepted criteria such as cubic feet per capita, pounds of total solids per cubic foot per 30 days, and pounds of volatile solids per cubic foot per 30 days. By analyzing operating reports from many plants throughout the country, he discovered that the only reliable correlation resulted from a detailed analysis of displacement time. Yet the only recognition of the true value of this work was in the recent investigations of high-rate digestion by Torpey, Sawyer and Roy, and Morgan, previously referred to.

The unit loading factor of cubic feet per capita used in the majority of state health department regulations combines a great number of uncontrolled variables, including volume of raw sludge and volatile and total-solids content. These all have a direct influence on operation of the digestion system.

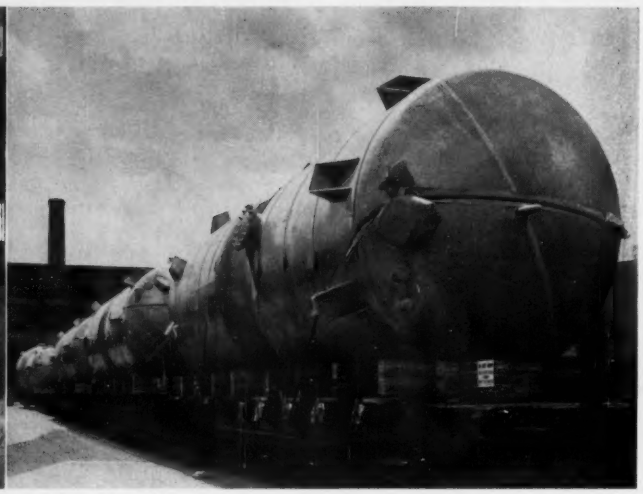
In conventional installations, the volume of raw sludge per capita per day is different for each type of treatment because of differences in solids characteristics, and it varies from plant to plant for any one type of treatment depending on individual operating procedures. With prethickening, the varying influences of these operating procedures are leveled off, and unit raw-sludge volumes for each type of treatment are reasonably uniform. This means that digester loading can be predicted more accurately and, accepting the proven solids detention basis, it has been demonstrated that the capacities recommended in Table VI are within the limits specified in state health department regulations.

This new system offers many advantages of particular interest to operating personnel and regulatory agencies. The process is extremely stable with alkalinity concentrations in the range of 5,000 ppm. Sludge transfer from sedimentation tanks to sludge storage is continuous and automatic, requiring only a minimum of control measures. Troublesome and costly symptoms of inefficient digestion such as accumulations of scum, inert sludge, silt and foul supernatant are eliminated. Heat requirements are substantially reduced, thus minimizing the need for auxiliary fuel in the smaller plants, and increasing the amount of sewage sludge gas available for other purposes in the larger plants. The sum of these advantages is efficient, economical, and trouble-free operation.

(*This article has been prepared from the paper to be presented by Mr. Cerny at the ASCE Annual Convention in Pittsburgh, before the Sanitary Engineering Division session presided over by Roy J. Morton, Chairman of the Division's Executive Committee, and Robert F. Brandt, a member of its Committee on Session Programs.*)

Welding of large aluminum structures

Two aluminum tanks, 16 ft in diameter by 8 ft high, were installed at top of Alcoa Building in Pittsburgh, Pa. Inert-gas-shielded metal-arc welding process was used on shell plates of clad alloy 3003, 5/16 in. thick. Note snow in this photo.



Low-pressure storage vessels of aluminum alloy 3003 (10 ft in diameter, 17 ft high) have been loaded on cars in preparation for shipment by rail.

Today in discussing the subject of welded structural aluminum, it is possible to refer to many large existing structures. Aluminum and aluminum alloys are an important group of construction materials which are finding ever increasing application in large structures, particularly in the chemical and petroleum industries and in transportation. Design, fabrication, and erection procedures are well established. A wide choice of alloys in various product forms is competitively available. Corrosion histories are being accumulated. Future developments in production, design, and fabrication will accelerate the use of these alloys in all types of construction.

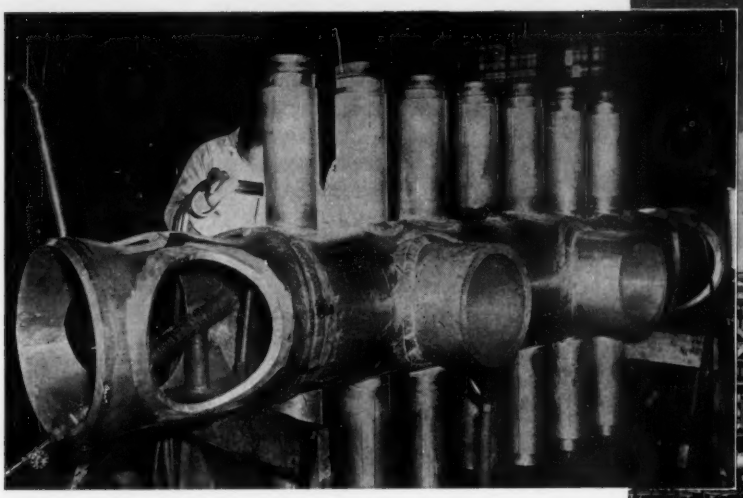
It is possible here to mention and illustrate only a few of the many large welded aluminum structures that have been built. No attempt will be made to cover details of metallurgy, corrosion resistance, or cost of materials and labor. A bibliography of recent references[1–22] is appended for the attention of those who are particularly interested in these subjects. A large number of specifications and codes have been written for wrought aluminum and aluminum alloys, covering plates, sheets, shapes, bars, rods, pipe, tube, and welding filler metal—particularly by ASTM, AWS, ASME, ASCE, AMS, API, SAE, and the U.S. Army, Navy, and Air Force. Many of the specifications duplicate, overlap, or are equivalent to portions of others. N. E. Woldman[17] has written a good correlation of these codes.

Typical large welded aluminum structures include storage tanks, pressure vessels, process equipment, roofs and building structures, towers and erection booms, railroad tank cars, truck tanks and bodies and trailers, pipelines, ships, mechanical equipment, military bridges and boats and pontoons, as well as various welded subassemblies, such as fuel tanks for aircraft. Storage tanks, pressure vessels, and process equipment probably make up the bulk of the tonnage used in large welded aluminum products, with corrosion resistance and toughness at low temperatures perhaps the most important criteria for selection, coupled with recent developments in cutting and welding processes.

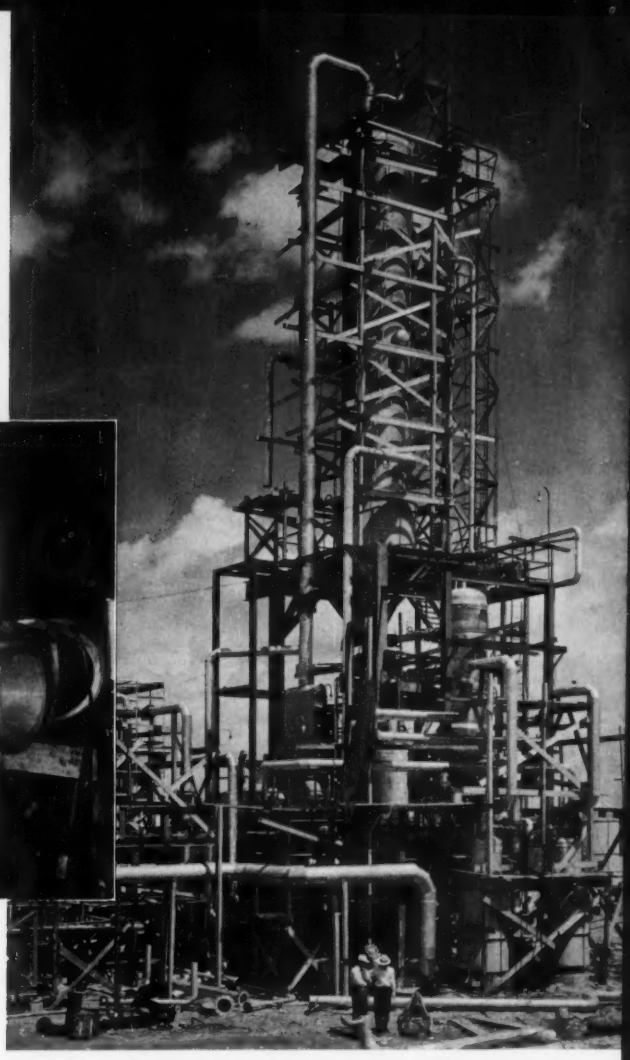
Storage tanks, in a wide range of sizes, usually of cylindrical shape, have been built for the storage of such chemicals as water, glacial acetic acid, fatty acids, crude oils, glycerol, and formaldehyde. Pressure vessels and process equipment are designed and built in accordance with the ASME Code for Unfired Pressure Vessels, using materials conforming to ASTM-ASME

LUDWIG ADAMS, M. ASCE

Research Engineer, Pittsburgh-Des Moines Steel Company, Neville Island, Pittsburgh, Pa.



High-pressure aluminum piping manifolds are being welded in fabrication shop.

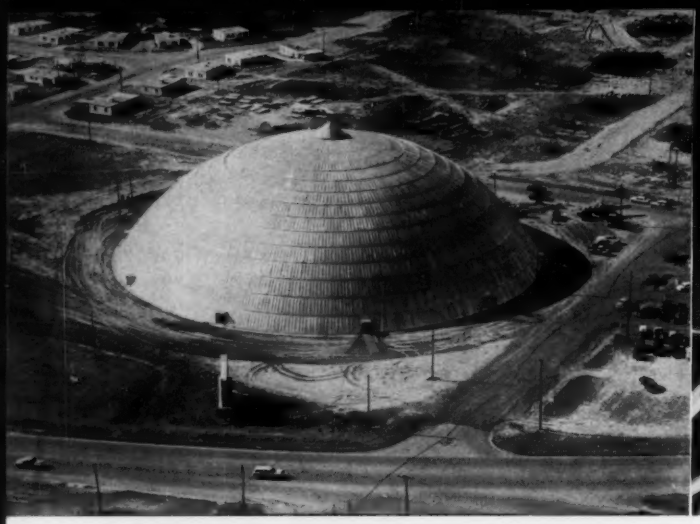


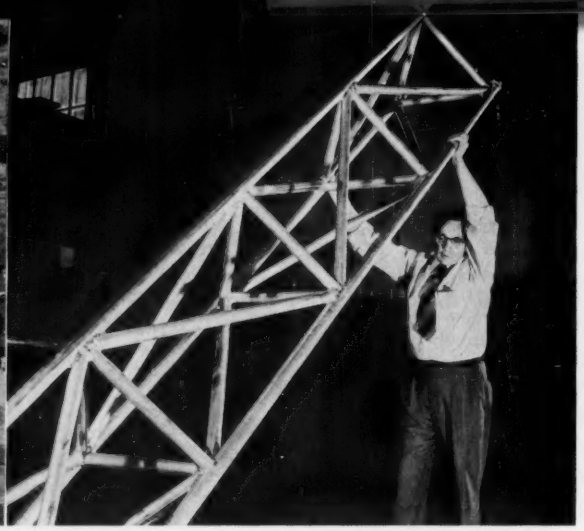
Tower for low-temperature fractionation of air was welded using argon-shielded tungsten-arc process.

Specifications. Marshall Holt's recent article[2] on aluminum pressure vessels is especially pertinent. Photographs show several storage-type low-pressure vessels and a high-pressure piping manifold. Overhead welding of pressure piping is practical, using the inert-gas-shielded metal-arc process. Also illustrated is a large tower for the low-temperature fractionation of air, welded by the argon-shielded tungsten-arc process.

An unusual auditorium seating 12,000 people is described by John Lund.[10] This Semisphere Building built for R. G. LeTourneau, Inc., in Longview, Tex., was constructed as a spherical segment with a chord of 300 ft, a rise of 85 ft, a spherical radius of 175 ft, and a surface area of 70,000 sq ft. "Most unusual of all," states Mr. Lund, "none of the workers who erected the building left the ground."

Practicability of overhead welding is demonstrated by welder using inert-gas-shielded metal-arc process on pressure pipe.





Auditorium for 12,000 people is unusual structure assembled at ground level from aluminum sheets 7 ft × 12½ ft × ⅛ in. thick. Called Le Tourneau Semisphere, it was built by R. G. Le Tourneau, Inc., adjacent to its plant at Longview, Tex. See "Civil Engineering," March 1954, p. 94. Portable gin pole (above) is of welded 6061-T6 tubing, and 60-ft length has rated load capacity of 6,000 lb.

TABLE I. Product availability

Alloy								
					Shapes		Tube & Pipe	
ASTM	Al. Assn.	Old	Plates	Rods & Bars	Rolled	Extrd	Extrd	Drawn
990A	100	2S	*	*	...	...	...	...
M1A	3003	3S	†	*	...	*	*	‡
MG11A	3004	4S	†	...	...	...	...	*
CS41A	2014	14S	§	*	*	*	*	...
CG42A	2024	24S	†	*	...	*	*	*
	6951	J51S	*	*	...	*	*	...
GR20A	5052	52S	*	*	...	...	...	*
GR40A	5154	A54S	*	*	...	...	...	...
GS11A	6061	61S	*	*	*	*	*	*
	6062	62S	...	...	...	*	*	*
GS10A	6063	63S	...	...	...	*	*	*
	6066	66S	...	...	...	*	*	...
ZG62A	7075	75S	†	*	...	*	*	...
G1A	5050	150S	*	*	*	...	...	...
GM40A	5086	K186	*	...	...	...	...	...

* Available.
† Available also as clad material.
‡ Available also clad inside only.
§ Available only as clad material.

For the use of aluminum alloys in the construction of tank roofs and top shell rings, see Appendix F of American Petroleum Institute Standard 12C for Welded Oil Storage Tanks, covering non-mandatory recommended practice.

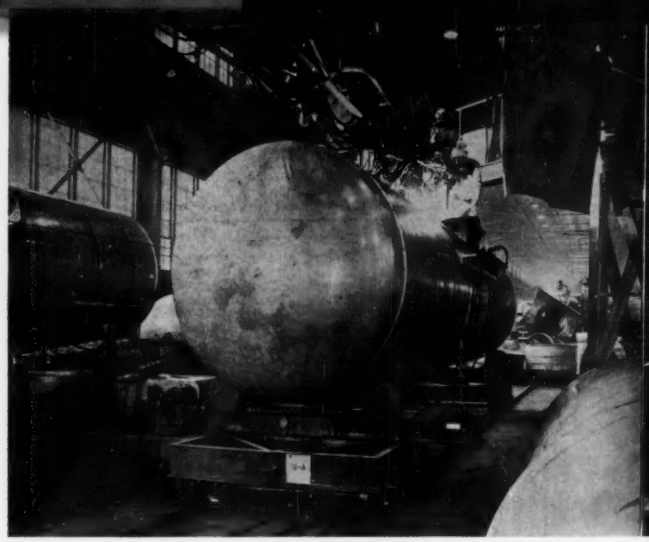
Portable gin piles are fabricated of tubing for such jobs as the erection of power-line towers. The one shown in a photograph is rated at a 6,000-lb safe load capacity up to a 60-ft assembled length.

Aluminum alloys commonly used for railroad tank cars include 5052, 5154, and 6061. The ASM Metals Handbook, 1954 Supplement, p. 56, discusses

TABLE II. Chemical requirements (aluminum is remainder)

Alloy											Others	
ASTM	A.A.	Old	Cu	Fe	Si	Mn	Mg	Zn	Chr	Ti	Each	Total
990A	1100	2S	0.20	*	*	0.05	....	0.10	....	....	0.05	0.15
996A	1160	99.6	0.25	†	†	....	....	....	....	....	"	"
G1A	5050	150S	0.20	0.70	0.40	0.10	1.0–1.8	0.25	0.10	....	"	"
GM40A	5086	K186	0.10	0.50	0.40	0.2–0.7	3.5–4.5	0.25	0.25	....	"	"
GR20A	5052	52S	0.10	‡	‡	0.10	2.2–2.8	0.20	.15–.35	....	"	"
GR40A	5154	A54S	0.10	‡	‡	0.10	3.1–3.9	0.20	.15–.35	0.20	"	"
GS11A	6061	61S	.15–.40	0.70	.4–.8	0.15	0.8–1.2	0.25	.15–.35	0.15	"	"
GS11A cladding	7072	....	0.10	§	§	0.10	0.10	0.8–1.3	....	....	"	"
M1A	3003	3S	0.20	0.70	0.60	1.0–1.5	....	0.10	....	....	"	"
M1A cladding	7072	....	0.10	§	§	0.10	0.10	0.8–1.3	....	....	"	"
MG11A	3004	4S	0.20	0.70	0.30	1.0–1.5	0.8–1.3	0.10	....	....	"	"
MG11A Cladding	7072	....	0.10	§	§	0.10	0.10	0.8–1.3	....	....	"	"
CS41A	2014	14S	4.4	....	0.8	0.8	0.4	....	....	....	"	"
CG42A	2024	24S	4.5	....	....	0.6	1.5	....	....	....	"	"
....	6951	J51S	0.25	....	0.35	....	0.6	....	....	....	"	"
ZG62A	7075	75S	1.6	....	....	....	2.5	5.6	0.30	....	"	"
....	4043	43S	0.30	0.80	4.5–6	0.05	0.05	0.10	....	0.20	"	

Notes: Analyses given in percent of maximum unless range given.
Alloys 996A, 990A, M1A, GR20A and GS11A formerly were designated as A3, A2, M1, GR1 and GS21 respectively.
* Fe plus Si shall not exceed 1.0 percent.
† " " " 0.4 ".
‡ " " " 0.45 ".
§ " " " 0.7 ".



Aluminum railroad tank car is being welded with automatic consumable-electrode equipment. Process is also known as inert-gas-shielded metal-arc welding.

Lightweight military bridges of tank-carrying capacity are being fabricated of aluminum. Here vertical member of 60-ton bridge is being welded with tungsten-arc equipment.

railroad applications. It states that "aluminum tank cars were first introduced in 1928 and there are now nearly 2,000 in service. These are built to specifications of either the Association of American Railroads or the Interstate Commerce Commission, depending on the commodity to be handled." Cook, Channon and Hard discuss,[14] among other things, truck trailer tanks and a 40-ft, 5-ton crew boat. The 72-ft, 45-ton auxiliary motor yacht *Morag Mhor* was recently launched in England.[7]

Military bridges of tank-carrying capacity have been fabricated of aluminum shapes. The tungsten-arc welding of a subassembly for such a bridge is shown in a photograph.

Available wrought alloys

Aluminum and aluminum alloys for large welded structures are available in many forms and in a slightly confusing array of designations or nomenclature, as to alloy and temper. The new ASTM designations[18] are explained in ASTM Specification B275-55, "Codification of Light Metals and Alloys, Cast and Wrought," and in Specification B296-54T, "Temper Designations of Light Metals and Alloys, Cast and Wrought." Product forms for welded structures are generally available[20] as shown in Table I.

Quoting from *Welding Aluminum*,[22]

There are two major groups of wrought aluminum alloys: (1) non-heat-treatable alloys and (2) heat-treatable alloys. The former can be strengthened only by means of cold working. The latter require suitable thermal treatment to develop optimum properties. Temper designations are standardized and are suffixed to the alloy designation to signify mechanical and/or thermal treatment. Thus:

—F	means	as fabricated
—O	"	annealed, recrystalized (soft)
—H	"	strain hardened
—H1	"	strain hardened only
—H2	"	strain hardened and then partially annealed
—H3	"	strain hardened and then stabilized
—W	"	solution heat treated—unstable temper
—T	"	treated to produce stable tempers other than F, O, H
—T3	"	solution heat treated and then cold worked
—T4	"	solution heat treated and naturally aged
—T5	"	artificially aged
—T6	"	solution heat treated and then artificially aged
—T7	"	solution heat treated and then stabilized
—T8	"	solution heat treated, cold worked, artificially aged
—T9	"	solution heat treated, artificially aged, cold worked
—T10	"	artificially aged and then cold worked

Additional digits are sometimes added to the "H" group to indicate the degree of strain hardening or annealing, or to the "T" group to indicate certain variations in treatment. Some heat-treatable alloys are not produced in the "W" temper because after quenching they rapidly age at room temperature to the "T" temper. Alloys which are produced in the "W" temper may be converted to the "T" temper by a low-temperature artificial aging treatment."

TABLE III. Typical mechanical properties—annealed[21]

Strengths are shown in psi

Alloy			Tensile min.	Yield min.	Elong. min.	Shear Single	Fatigue 5×10^8	Brinell 500-10	Lb. Cu. In.
ASTM	A.A.	Old							
996A	1160	CD1S	9500	2500	25	6500	3000	19	0.098
990A	1100	2S	11000	3500	28	8000	5000	23	0.098
G1A	5050	150S	18000	6000	20	12000	12000	36	0.097
GM40A	5086	K186	35000	14000	14	23000	...	16	0.096
GR20A	5052	52S	25000	9500	18	16000	17000	45	0.097
GR40A	5154	A54S	30000	11000	18	18000	17000	57	0.096
M1A	3003	3S	14000	5000	23	10000	7000	28	0.099
M1A-clad	...	...	13000	4500	23	9000	...	..	0.099
MG11A	3004	4S	23000	8500	16	14000	14000	45	0.098
MG11A-clad	...	...	22000	8000	16	14000	...	..	0.098
CS41A	2014	14S	27000	14000	..	18000	13000	45	0.101
CG42A	2024	24S	27000	11000	..	18000	13000	47	0.100
...	6951	J51S	16000	7000	29	...	...	..	0.097
ZG62A	7075	75S	33000	15000	..	22000	...	60	0.101

Notes: Yield stress is at 0.2 percent offset.
Elongation is in percent in 2 in.
Single-shear values obtained from double-shear tests.
Fatigue endurance limit based upon 500 million cycles of completely reverse stress (R. R. Moore type).
Brinell hardness is for 500-kg load on 10-mm ball.
For most aluminum alloys, Young's modulus of elasticity is about 10,300,000 psi; modulus of rigidity is about 3,800,000 psi; Poisson's ratio is about 0.33; bearing strength is about 1.8 times the tensile strength provided the edge distance, in direction of stressing, is not less than twice the hole diameter.

The chemical requirements of some of the wrought alloys, as shown in ASTM Specification B178-55T, are given in Table II, along with nominal compositions of several other alloys.

Typical mechanical properties[2,20,21] of some of the wrought alloys, for designation "O" (annealed), are shown in Table III.

Design and relative economy

As for the relative economy of aluminum, the following passage from Campbell[16] is quoted:

Since there are many structural materials stronger and less expensive than aluminum, it is selected for an unfired pressure vessel only where it offers a significant technical or economic advantage that cannot be matched by another material at less cost. The most common reason for the selection of aluminum is its corrosion resistance. The economic importance of minimizing the rate of disintegration of equipment handling corrosive chemicals is obvious. Often, resistance to general external attack by the polluted plant atmosphere is important. Even where corrosion rates are too low to destroy equipment rapidly, contamination caused by corrosion products may pose a serious problem in quality control. In many pressure-vessel applications where one of these factors is controlling, the choice of material narrows down to stainless steel or aluminum. Where product contamination is controlling, aluminum offers the peculiar advantage of colorless corrosion products.

Other advantages include aluminum's properties such as non-sparking, high reflectivity, and desirable low-temperature tensile and impact strength. Functional design, including proper choice of alloy for the application, as well as skill in structural design or stress analysis and proportioning, pays large dividends. The choice of alloy is governed by allowable unit stresses and weldability as well as by corrosion. Thus, Table IV shows the maximum allowable stress values for welded aluminum alloy plate SB-178, in accordance with the 1952 ASME Unfired Pressure Vessel Code, 1955 Addenda and Cases 1174 and 1185.

Construction considerations

The construction of large welded aluminum structures involves layout, cutting and edge preparation, shaping, assembly or fitting, welding, and of course inspection and testing. All this is much the same as for steel structures except for differences in cutting and welding processes and equipment.

Until just about one year ago, aluminum and aluminum alloys could be cut and their edges prepared by band sawing, shearing, machining, or chipping, but could not be flame cut for final welding edges, as for steel. Now the "inert-gas tungsten-arc" process[3,5,9]

TABLE IV. ASME allowable stresses for welded construction, psi

Alloy		Tensile min.	Max. stress for metal temp, deg F, not exceeding						
ASTM	A.A.		100	150	200	250	300	350	400
996A	1160	9500	1650	1650	1600	1450	1250	1200	1050
990A	1100	11000	2350	2350	2300	2100	1850	1600	1300
M1A	3003	14000	3350	3150	2900	2700	2400	2100	1800
M1A clad	...	13000	3000	2900	2700	2500	2200	2000	1700
MG11A	3004	23000	5650	5650	5650	5500	4650	3850	3150
MG11A clad	...	22000	5300	5300	5300	5200	4400	3700	3000
G1A	5050	18000	4000	4000	4000	4000	4000	3350	2800
GR20A	5052	25000	6250	6250	6200	6000	5400	4650	3900
GR40A	5154	30000	7350	7350	7350	7000	6400	5650	4900
GS11A-T6	6061	24000	6000	5900	5700	5400	5000	4200	3200
GS11A-T6 clad	...	24000	6000	5900	5700	5400	5000	4200	3200

Notes: The tensile minimum for GS11A-T6 and GS11A-T6 clad represents strength of full-section tensile specimen required to qualify welding procedures.
Joint efficiencies for welded aluminum are the same as for welded steel.

TABLE V. Strength and ductility of welded butt joints*

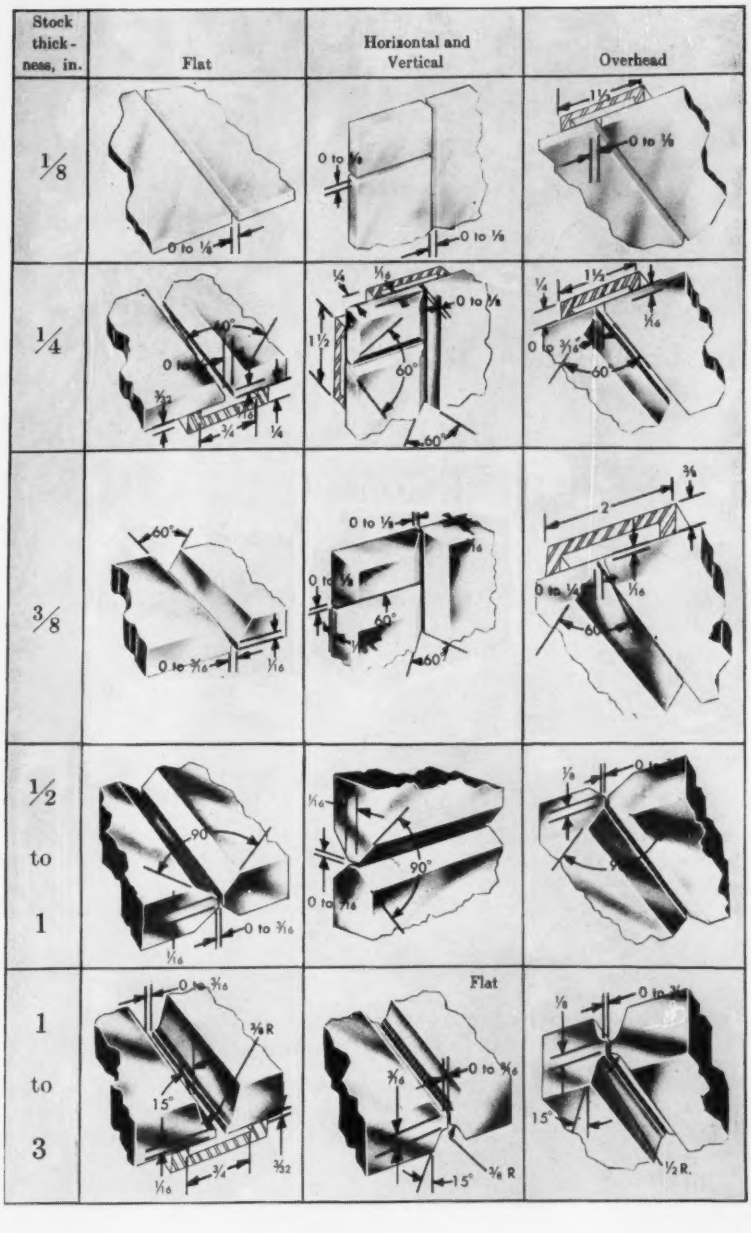
Alloy		Specified min. tensile strength of parent material, psi		Average tensile strength across weld, psi	Average free-bend elongation, %
Parent material	Filler wire	Annealed	Heat-treated		
Non-Heat-Treatable Alloys					
1160	1160	9,500	..	10,000	63
1100	1100	11,000	..	13,500	54
3003	1100	14,000	..	16,000	58
3004	3004	23,000	..	27,500	26
5052	5052	25,000	..	28,000	39
5154	5154	30,000	..	33,000	39
5056	5056	35,000	..	38,000	31
X5356	X5356	35,000	..	40,000	34
Heat-Treatable Alloys (Not heat-treated after welding)					
2014-T6	4043	..	64,000	34,000	9
6061-T6	4043	..	42,000	27,000	16
6062-T6	4043	..	42,000	27,000	16
6063-T5	4043	..	22,000	20,000	..
6063-T6	4043	..	32,000	20,000	..
6063-T83	4043	..	33,000	20,000	..
6063-T831	4043	..	28,000	20,000	..
6063-T832	4043	..	40,000	20,000	..
Heat-Treatable Alloys (Heat-treated and aged after welding)					
2014-T6	4043	..	64,000	51,000	5
6061-T6	4043	..	42,000	43,000	11
6062-T6	4043	..	42,000	43,000	11

* Made by the Argon-Shielded Tungsten-Arc or the Argon-Shielded Consumable Electrode Method.

TABLE VI. Approximate recommended conditions for butt welds with inert-gas consumable electrode

Stock Thickness, in	Position	Current, Amperes, d-c	Electrode Dia., in.	Wire Speed, in. per min.	Argon Flow, cu ft per hr	Arc Volts	No. of Passes	Weld Speed, in. per min. per pass	Electrode Consumption, lb per 100 ft
1/8	Flat	110	3/64	175	30	20	1	24	12
	Horiz. & vert.	100	3/64	170	30	20	1	24	12
	Overhead	105	3/64	170	40	20	1	24	21/2
1/4	Flat	200	1/16	170	40	25–29	1	24	8
	Horiz. & vert.	170	1/16	150	45	25–29	3	24	8
	Overhead	180	1/16	160	50	25–29	3	24	10
3/8	Flat	290	1/16	265	50	25–29	2	24	18
	Horiz. & vert.	190	1/16	160	50	25–29	2	24	18
	Overhead	200	1/16	170	50	25–29	3	24	23
1/2	Flat	300	5/32	130	50	25–31	3	16	29
	Horiz. & vert.	190	1/16	160	50	25–29	2	12	29
3/4	Flat	330	5/32	145	60	25–31	4	16	72
	Horiz. & vert.	240	1/16	215	60	25–29	4	8	72
1	Flat	400	5/32	170	60	25–31	5	12	180
	Horiz. & vert.	240	1/16	215	60	25–29	6	6	95
	Overhead	380	5/32	165	60	25–31	6	12	85
2	Flat	425	5/32	180	60	25–31	12	12	335
3	Flat / Overhead	450	5/32	190	60	25–31	30	20	500

FIG. 1. Edge preparations for welding are shown for different thicknesses of aluminum plate. See Table VI.



is capable of producing edges of sawlike quality, at high speed, such as 300 inches per minute (ipm) for $^1/_4$-in., and 50 ipm for 1-in. material, cutting square edges. The very high-temperature, high-energy arc between the material and a tungsten electrode melts and ejects the metal, and the gas protects the cut face from excessive oxidation. The gas is a mixture of argon and hydrogen, 65–35 percent, for automatic cutting, and 80–20 percent for manual cutting.

Aluminum may be welded by several processes[19,21,22] but for large structures two of them have proved the most practical and economical for all-position welding in the shop and field in thicknesses through 3 in. The two methods are known as "inert-gas tungsten-arc" and "inert-gas metal-arc." The latter is also known as "inert-gas consumable-electrode" welding. Typical test results[21] of butt-welded specimens are shown in Table V. Approximate welding procedures for butt joints $^1/_8$ to 3 in. thick are shown in Table VI. Corresponding recommended edge preparations are shown in Fig. 1.

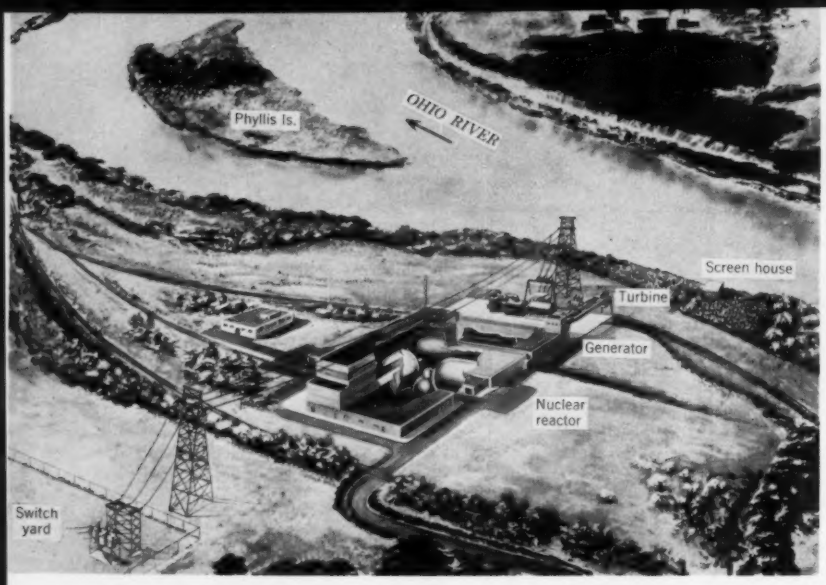
The welding procedure and operators must be qualified in accordance with the AWS Standard Qualification Procedure B3.0–41, which served as the basis for Section IX of the ASME Boiler and Pressure Vessel Code. Generally speaking, all tests and inspection methods used for steel are applicable to aluminum—except magnetic particle inspection.

It seems evident that the future will see still further developments in the production, design, and fabrication of aluminum and its alloys, and that these developments will accelerate the use of this metal in construction of all types.

(This article has been prepared from the paper to be presented by Mr. Adams at the ASCE Annual Convention in Pittsburgh, before a Structural Division session sponsored by the Division's Committee on Design of Lightweight Structural Alloys, that presided over by John Clark, chairman of this committee, and by Leo H. Corning, M. ASCE.)

Partial Bibliography

[1] Report of ASTM Committee B-7 on Light Metals and Alloys, Cast and Wrought, June 1956.
[2] Holt, Marshall, "Aluminum and Aluminum Alloys for Pressure Vessels, *Welding Journal*, June 1956, p. 308. Complete report is in Welding Research Council Bulletin No. 28.
[3] Hoglund, G. O., Welding and Cutting Aluminum," lecture delivered Feb. 20, 1956, abstracted in *Welding Journal*, May 1956, p. 501.
[4] Dowd, J. D., "Inert Shielding Gases for Welding Aluminum," *Welding Journal*, April 1956, p. 207.
[5] "Arc Cutting Makes Debut in [Aluminum] Tank Fabrication," *The Iron Age*, April 5, 1956, p. 103.
[6] Pickett, J. M., "Aluminum Alloys Move Into Structural Markets," CIVIL ENGINEERING, December 1955, p. 44.
[7] "Welding an Aluminum Yacht," *Welding Engineer*, Dec. 1955, p. 70.
[8] "Inert-Gas Metal-Arc Welded Aluminum Ups Tank-Truck Capacity," *Welding Journal*, Dec. 1955, p. 1201.
[9] "Inert-Gas Tungsten-Arc Cutting of Aluminum," *Welding Journal*, Nov. 1955, p. 1097.
[10] Lund, John, "70,000 Square Feet of [Welded Aluminum] Dome," *Welding Journal*, Oct. 1955, p. 992.
[11] "All-Welded Aluminum Deck-Edge Elevator," *Welding Journal*, Oct. 1955, p. 994.
[12] "Metals Selector, Aluminum Wrought Alloys," *Steel*, Oct. 10, 1955.
[13] "Welded Aluminum Trailer Trucks Beat Corrosion Problem," *Welding Journal*, July 1955, p. 681.
[14] Cook, L. A., Channon, S. L., and Hard, A. R., "Properties of Welds in Al-Mg-Mn Alloys 5083 and 5086," *Welding Journal*, Feb. 1955, p. 112.
[15] Tenner, Walter S., "Mechanical Properties of Welded 356 Aluminum Castings," *Welding Journal*, Feb. 1955, p. 128.
[16] Campbell, John B., "New Alloy Widens Future for Aluminum in Pressure Vessels," *Materials and Methods*, April 1954.
[17] Woldman, Norman E., "Digest of Ferrous and Nonferrous Alloy Specifications," *Iron Age*, Oct. 4, 1951 (reprint of Jan. 3, 1952, p. 19).
[18] ASTM Standards, 1955, Part 2, Non-Ferrous Metals.
[19] Welding Handbook, American Welding Society, 1950, pp. 687–715.
[20] Handbook of New Engineering Materials, 1955, pp. 79–94 (*Materials and Methods*, Reinhold).
[21] Welding Alcoa Aluminum, Aluminum Company of America, Pittsburgh, Pa., 1955.
[22] Welding Aluminum, handbook, Reynolds Metals Company, 1953.



General site arrangement of atomic power station now under construction at Shippingport, Pa., about 25 miles downstream from Pittsburgh, on Ohio River, is seen in artist's conception. Station is planned for completion in 1957.

R. B. DONWORTH

Vice President, Duquesne Light Company, Pittsburgh, Pa.

SHIPPINGPORT ATOMIC POWER STATION

Government cooperates with a private utility for commercial development of atomic energy

Before discussing features of the Shippingport Atomic Power Station, it will be well to mention the basis of the relationship between the Atomic Energy Commission and the Duquesne Light Company, and the underlying reasons why it was important, in early 1954, to proceed in this way.

In mid-1953 the AEC authorized the Westinghouse Electric Corporation to perform research and development for the design of a pressurized water reactor to produce at least 60,000 kw net of electric power, this being the first full-scale atomic power-plant project to be undertaken in the United States. Late in the fall of that year, it was decided to open up the conventional part of the work for participation by private industry, and proposals were requested from interested private parties. In March 1954 the Duquesne Light Company was selected from a list of nine bidders, on the basis that its proposal was most advantageous to the Government. Subsequently a contract was negotiated in which the Duquesne Light Company agreed:

1. To provide the site for the entire atomic power station.
2. To design and construct the conventional part of the station.
3. To contribute structures, facilities, and services up to a total cost of $5,000,000 for the nuclear portion.
4. To operate the entire plant, including taking complete responsibility for the turbine-generator portion plus providing the operating and maintenance payroll for the nuclear portion for a force not exceeding 100 people.
5. To purchase steam on the basis of the electric energy generated by that steam.

The AEC assumes responsibility for all other items in connection with the project and its operation, including the replacement of reactor cores as needed, the disposal of spent cores, and all liability for damage due to radioactivity. It is also making available much-needed reactor information as well as facilities for the instruction and training of operators.

Thus the Government is saved the cost of providing land, non-nuclear facilities, operating manpower, transmission lines, and a market for the electric output. Also, it is receiving the benefit of the utility company's experience in power-plant design and operation, which includes the very important requirement that the atomic plant take its share of system irregularities and emergencies. The utility has the opportunity to contribute to the advancement of the use of atomic energy and to obtain directly reactor information and operating experience with nuclear equipment without having to bear alone the high costs which this extraordinary development entails.

This arrangement was in effect an orderly transition from the Government monopoly of reactor development for military use, to development for strictly peacetime purposes, the program for which is now, in 1956, well started along a number of different lines.

The important things expected from this arrangement were the creation of the opportunity for advancing the field of atomic power technology and know-how, and the dissemination of knowledge in this field. For many reasons the Shippingport Atomic Power Station, being the first of its kind and being designed for testing and development, cannot in itself be economic, but it will be a step of tremendous importance toward that end for other, later plants.

Over a period of many years the utility industry has reduced the cost of electricity largely through improvements in two directions. The first is reduced fuel consumption per kilowatt-hour as a result of improved technology; the second is greater utilization of investment through a higher load factor and a reduction in spare capacity. The increased load factor is partly a system gain due to diversity and improved utilization by customers, and partly an equipment gain due to greater reliability. This gain in reliability, along with the

greater use of interconnections with other utility companies, has also caused the reduction in spare capacity.

The long-time effect of these factors has been to bring about a very substantial reduction in the price of electricity to the consumer, but recently this trend has been reversed. It now appears that rates of gain due to these causes are leveling out and that the cost of electric energy produced from conventional fuel will gradually rise as a result of probable long-term increases in the costs of fuel, labor, and supplies. If such a rise is to be avoided or limited, the improvement must be derived from an entirely new source, and at present the most likely such source appears to be atomic energy.

The development of atomic energy for power is however not simple. It is a highly complex matter involving the development of much new technology in methods, materials, and processes, of which little has previously been known. We are in the anomalous position of being able to generate large quantities of heat at far higher temperatures than have heretofore been available to us, but of having to generate this heat under new and obscure conditions which, at the present time, limit its utilization to lower temperatures than those we have actually been using for some years in conventional installations.

Of course the related problems will be solved, but it will take much trial and error, and time, before the new source can become economic and commonplace. And even then development will still go on, and reactors will continue to become more efficient, more reliable, and of greater economic value, just as our splendid coal-burning steam boilers are still undergoing improvement today.

Items of special interest

Since the Shippingport Atomic Power Station and its pressurized water reactor—known as the PWR—have been fully described in many periodicals and publications, a general description will not be repeated here. (See "Description of the Pressurized Water Reactor (PWR) Power Plant Shippingport, Pa.," by J. W. Simpson, M. Shaw, R. B. Donworth, W. J. Lyman, I. H. Mandil, N. J. Palladino, Proceedings of the International Conference in Geneva, August 1955, Vol. 3.) However, a number of items of special importance or interest will be presented. They will be shown in their relation to the overall atomic power plant and discussed without reference to the design responsibility, whether that of Westinghouse (on behalf of the AEC) or of the Duquesne Light Company.

The core of the reactor consists of about 15 tons of uranium fabricated into fuel elements, some as thin slabs and some in rod form, all clad with an alloy of zirconium. The primary cooling water passes through the void spaces between the elements and removes heat generated in the interior of the elements and conducted to the outer surface of the cladding. The maximum permissible temperature of this cladding is one of the most critical limits in the entire reactor design. The integrity of the cladding must be preserved to a very high degree in order to protect the uranium within and to minimize the contamination of the primary water system by the highly radioactive products of uranium fission. The temperature of the cladding of the hottest elements must therefore be kept below that at which structural strength would be impaired or serious corrosion induced.

It is also important that boiling of the primary water at local hot spots be prevented or limited, since the insulting effect of steam bubbles can cause an almost instantaneous temperature rise in the very sensitive fuel elements to the point of destruction or even vaporization of the element materials. This problem is made more difficult by the facts that the generation of heat over the whole reactor is far from uniform and that the distribution is not precisely known, so that accurate proportioning of the flow of water is not possible at this time.

The water in the primary circuit, in addition to transporting heat from the reactor to the steam generator, also serves as a moderator to slow down the fission neutrons to the velocity range in which they will cause more fissions. The mass of water present between the fuel elements then becomes important to the continued functioning of the reactor, so much so that expansion or contraction of the water due to a change of a few degrees in temperature has a controlling effect. For this reason, the *average* temperature of the water in this reactor, except during transient changes, is maintained very close to 525 deg F, regardless of the total temperature rise. The ultimate effect of this is to produce steam at varying pressure, about 860 psia (lb per sq in. absolute) at no load and 600 psia at full load. Superheat is obviously out of the question, so we are faced with a very unusual heat cycle.

When the effect of regenerative feedwater heating is added to the cycle, a thermal efficiency of about 29 percent is attained, which compares with about 38 percent for recent high-pressure, high-temperature cycles.

The design capability of 60,000 kw net was stabilized at the outset, but it has been recognized that test and experience will eliminate many of the uncertainties, and that higher capabilities will no doubt result from improvements in future cores. For this reason the turbine generator, and as far as possible all other components, both nuclear and conventional, are designed for a gross generation of 100,000 kw.

The primary water, which as stated previously both moderates the neutron velocity and carries heat from the reactor to the steam generators, must be maintained at a 2,000-psi pressure to prevent boiling. Since this water will carry some contamination and will itself be radioactive, the system can be permitted only an infinitesimal leakage rate. There are four parallel primary water circuits each including a 1,500-kw pump, four 18-in. gate valves, one 18-in. check valve, and some smaller connections; and the total water volume is about 3,000 cu ft. The difficulties in making such a system really tight are obvious.

Although a substantial part of the plant is said to be "conventional"—that is, the turbine generator, condenser, main and auxiliary transformers, electrical system, water intake, etc.—there are many departures from the usual.

As we have seen, the 100,000-kw turbine uses unsuperheated steam at pressures varying with load. It is provided with a very large moisture separator between sections of the machine, and it operates at 1,800 rpm.

More than the usual reliability is designed into the auxiliary electrical system, even to the use of a 400-kw diesel generator set for a very special type of emergency. This is required by a characteristic of a reactor—that it cannot, instantly, be shut down to zero heat production. A small but definite quantity of heat is produced as a result of continued radioactive decay of the products of fission in the fuel elements. The rate of heat production diminishes gradually but for a period of several days it continues to exceed the rate of heat loss by radiation and conduction. It is therefore necessary that a suitable though small flow of cooling water be available during almost any conceivable emergency in order to avoid damage to the core and components from excessive temperatures.

Novel facilities required

Other novel facilities required in a nuclear power plant include:

Radiochemistry laboratories.

A "clean" room in which conditions approaching surgical cleanliness are maintained during core assembly.

Health physics facilities including instruments for checking radiation levels, exposure of operators to radiation, and other matters related to the protection of employees from radiation hazards.

Fuel handling and storage. New cores and core elements are relatively inactive and their handling requires principally protection against contamination and damage to precision manufactured parts. On the other hand, spent or partially spent core material is highly radioactive and cannot be handled by ordinary methods. The removal of a core or core parts therefore requires a complex arrangement of canals, locks, gates, and submerged storage pits, together with special precision crane apparatus for the remote handling of such materials entirely under a shield of water. A depth of 20 ft of water is required to provide effective shielding. The natural circulation of such water around and through the radioactive materials also removes heat which continues to be generated. Special television equipment is available for examining radioactive parts from a safe position.

A waste disposal plant, representing an investment of about $1,500,000, is provided for processing waste materials that must leave the plant.

Concrete shielding around radioactive areas, especially the reactor proper. In other articles of this symposium much is said about the massive concrete walls and slabs. In the reactor area these are required for the attenuation of radiations, particularly gamma rays, which are continuously emanating from an active or spent core. A 5-ft thickness of concrete in most cases is adequate for this purpose. Penetrations through this concrete for piping, electric circuits, etc., must be carefully designed in each case to avoid straight paths, which could result in the escape of beams of radiation.

It will be seen from this brief description of the problems of an atomic power plant that there is much to be done before such plants can be built with the confidence that we have in conventionally fueled plants. Designs cannot be based on full knowledge of the fundamental requirements, or of mechanisms, or of materials, and only time and experience oft-repeated will provide answers to the problems we have encountered and those which will arise as further progress is made.

(This symposium on the design and construction of the Shippingport Atomic Power Station, including the two articles that follow, was prepared from papers to be presented by the authors at the ASCE Annual Convention in Pittsburgh, before the Power Division session presided over by R. B. Horner, a member of the Division's Program Committee.)

Structural features of reactor plant

H. T. EVANS, M. ASCE

Structural Engineer, Stone & Webster Engineering Corporation, Boston, Mass.

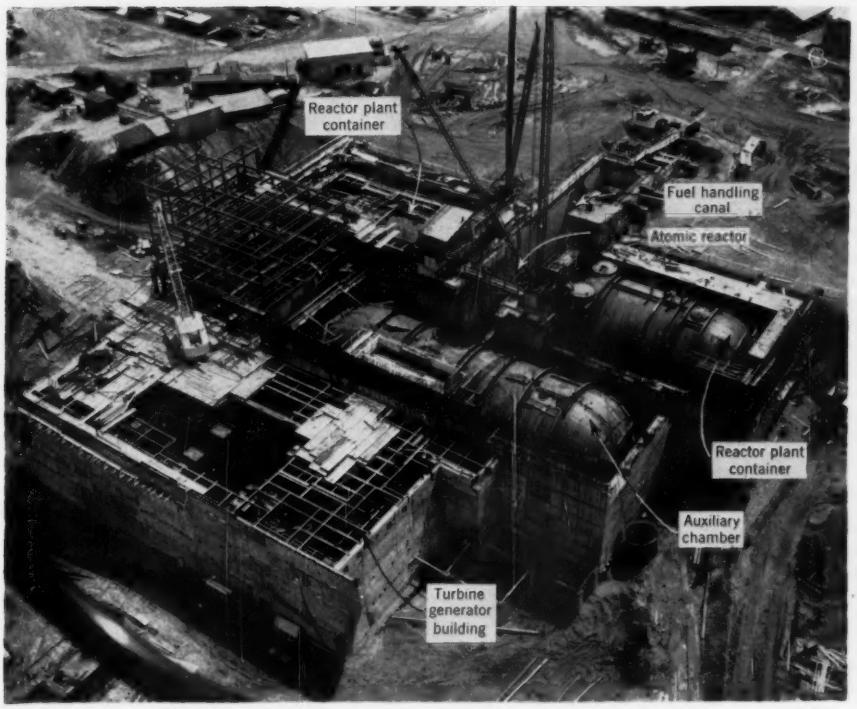
An atomic-energy power station presents new and unusual problems to the structural engineer as well as to the mechanical and electrical engineer, and structural considerations enter largely into the determination of the plant layout.

The most important major requirement of the design from the structural engineer's point of view is the necessity for enclosing the nuclear reactor portion of the plant in a tight container of large volume. This is not required because of any danger of a violent atomic explosion, since power plant reactors are normally so designed that this cannot occur. It is, however, considered advisable to guard against the remote possibility that radioactive vapors or fission products might be released as a result of the rupture of a pipe or some such "incident."

At the Shippingport Atomic Power Station, water under high pressure is heated in the reactor and pumped through four loops of stainless steel pipe to four heat exchangers. These generate the steam for the operation of the turbine. This high-pressure water is called the "coolant." If the "coolant" water should be released through a pipe rupture it would flash into steam, which under certain conditions could contain radioactive particles. The container is designed to hold all the vapor which might be liberated in the event of such a "coolant" pipe rupture.

The first outstanding example of a "container" was the 225-ft steel sphere constructed at West Milton, N. Y., in 1953 to house the General Electric Company's prototype of the power plant for the submarine *Sea Wolf*. That sphere has a gross volume of nearly six million cubic feet, and with this large volume the internal pressure anticipated in the event of an "incident" is relatively low. However, a very large low-pressure container of this type would be unsuitable for the Shippingport plant because of certain basic requirements established for the project by the AEC, Westinghouse, and the Duquesne Light Company, none of which would be met by the East Milton arrangement. These are as follows:

1. The reactor plant is to be housed in a substructure substantially underground and completely shielded by earth or concrete so that persons coming near it need have no concern as to the radioactivity within the container, either during normal operation or in the unlikely event of the release of radioactive vapors or fission products inside it.
2. The arrangement of the plant is to be such that normal operation can



Arrangement of first commercial atomic power plant to be built in United States is clearly seen in aerial construction view.

be carried on with no personnel inside the container.

3. Provision is to be made for replacing reactor fuel elements by an under-water operation requiring a large canal serviced by special manipulating cranes. This canal is required to be entirely outside the container, but one end of it must come directly above the reactor.

To keep down the size of the container it was evident that it should be designed to hold vapor at the highest practicable pressure. As a matter of judgment it was decided that this pressure should not materially exceed 50 psi, since any much higher pressure would make it difficult to seal the many necessary penetrations of the container shell. In the final design these penetrations included six air-lock personnel entrances, eight large hatchways for handling equipment, one very large hatchway over the reactor, and literally hundreds of electrical connections and pipes.

With a possible pressure on the order of 50 psi, it is necessary for the container to conform to the Commonwealth of Pennsylvania Regulations for Unfired Pressure Vessels. The ASME Boiler and Pressure Vessel Code was made the basis of the design.

A welded steel shell offered the only reasonable solution to the problem. Under the code, if the thickness of the plate exceeds 1 in. for SA212 steel, or $1^1/_4$ in. for SA201 Grade B firebox-quality steel, complete stress relieving is necessary. This it was essential to avoid, as the structure is too large for annealing after welding within any reasonable cost.

It was also evident that the container would probably be in the shape of a cylinder rather than a sphere in order to obtain the necessary volume without excessive depth for the underground construction. The limitations imposed by a pressure of approximately 50 psi and by a plate thickness of 1 in. or $1^1/_4$ in., together with the design stress allowable under the code, made it necessary to restrict the maximum diameter of the cylinder to approximately 50 ft. Figures derived from the probable total amount of steam being released, indicated that the net container volume should be about 470,000 cu ft. Adding an estimated 130,000 cu ft for the volume displaced by equipment, piping, shielding and miscellaneous structures within the container, the total required gross volume was estimated as approximately 600,000 cu ft.

The next step was to make a space layout to determine the feasibility of installing the steam generators within a 50-ft diameter. This worked out very well. It was found that two steam generators could be placed side by side in a 50-ft cylinder, thereby making possible an efficient arrangement with the reactor in the middle and a pair of steam generators on each side of it. It was also evident, however, that a cylinder 50 ft in diameter with a volume of 600,000 cu ft would be more than 300 ft long. Therefore the use of two or more cylinders side by side was also given consideration in order to obtain a more compact layout if possible, and for other reasons which will be touched upon later.

Tentative layouts and very rough comparative estimates were then made of many possible container arrangements and their concrete enclosures.

In a pioneering project such as this it was inevitable that many of the roads explored would lead to dead ends. No description of the structural engineers' work would be complete without some examples of this.

Five of the earliest schemes considered are shown in plan and cross section in Fig. 1. The cost comparisons, as might be expected, indicated that the single sausage-shaped container would be the most economical, and that it is less costly to have the container and its

enclosure extend somewhat above the ground (Schemes 2, 4 and 5) than to have the top of the enclosure at ground level (Schemes 1 and 3). The grouping of four spheres around a central sphere (Scheme 5) proved to be the least economical. A sphere requires one-half as much steel-shell thickness as a cylinder of the same diameter under the same pressure, but it is an awkward shape to work with. Although several schemes involving spherical containers were tried, none proved suitable for the requirements of this project. It will be observed, however, that the ends of the cylinders are hemispherical. In the final arrangement, a single small sphere contains the reactor.

While these five early schemes were under consideration, a great deal of thought was being given to the possibility of segregating the steam generators either singly or in pairs in such a manner that if one of them were in need of repair, its part of the container could be completely cut off from the rest so that repairs could be carried on while the steam generators in the other part remained operable. The groups of four chambers around a reactor chamber indicated by Schemes 3, 4 and 5 (Fig. 1) were a part of this concept. The structural cost was found to be high, however, since if the coolant should escape and flash into vapor, a large part of the volume would come from around the reactor itself, and the necessary effective container volume minus that segregated for repairs would still be very large. That is to say, the container as a whole would have to be made appreciably larger so as to have an adequate effective volume available when one of the steam generator chambers was segregated. Furthermore, the gates or valves that would close the interconnections to the segregated chamber and seal them against a pressure of 50 psi would require a special pioneering design and would be very expensive. The net result was that, although an arrangement permitting segregation of one or two steam generators for repair would probably reduce the number of days per year that the plant would be out of service, it would add more to the structural cost than would be justified for this purpose.

An early decision was therefore made that pressure segregation of one or more steam generators for repair was not required. It then seemed likely that the single large cylindrical chamber would be the answer. However, the breakdown of the container into several chambers was subsequently found expedient for other reasons which will be explained later.

The five schemes shown in Fig. 1 all include steel containers housed in concrete structures, meeting the basic requirements of complete shielding of the reactor part of the plant. At the same time, as shown in Fig. 2, a study was made of a scheme whereby the concrete shielding would be placed inside the steel container shell in the form of a lining, and earth would be backfilled around and over the outside of the shell for additional shielding. The concrete lining would give the shell the necessary stiffness to resist the earth pressure. With this arrangement, numerous tunnels, pits and trenches would be required in the backfill for the many penetrations for access and for piping and conduits.

The cost comparison showed no significant saving, and this approach to the problem was given up for several reasons. A detailed discussion of all the reasons would take more space than is available here. It may be mentioned, however, that regardless of structural considerations, this type of design would make it impossible to periodically inspect the steel shell of the container as required by the code. Also, the time required for construction would be greatly increased by the necessity for installing the concrete lining after the container shell had been tested and

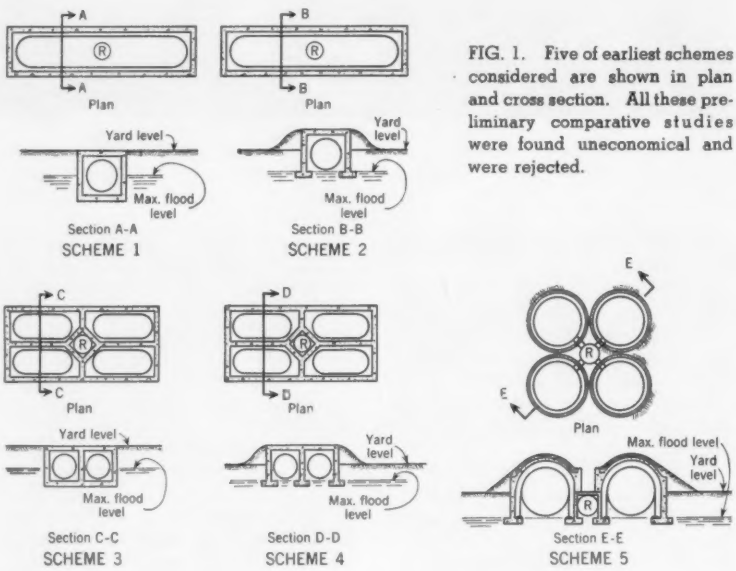


FIG. 1. Five of earliest schemes considered are shown in plan and cross section. All these preliminary comparative studies were found uneconomical and were rejected.

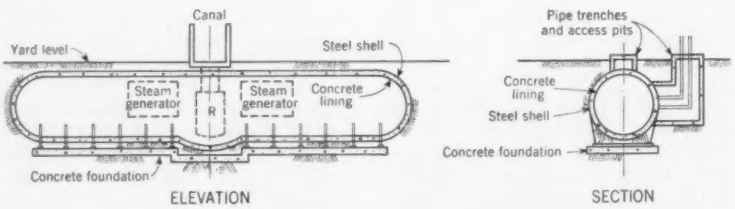


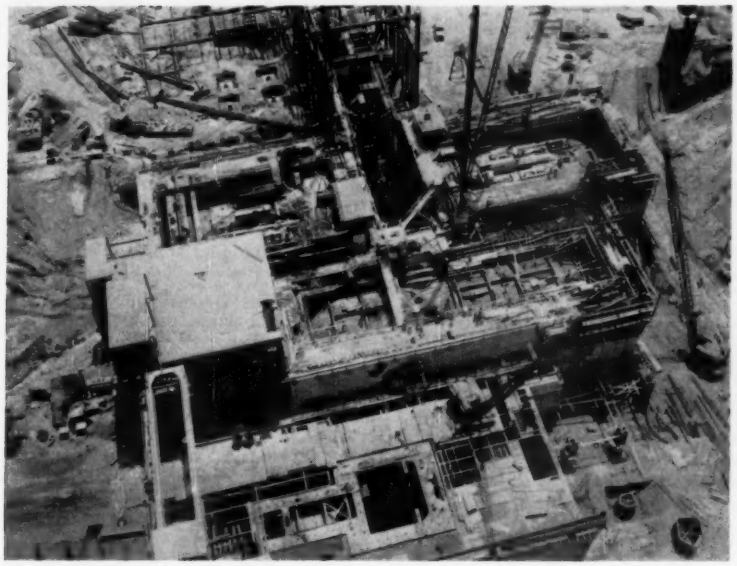
FIG. 2. Preliminary design was prepared with concrete shielding inside of steel container and with backfill over outside for additional shielding. This design was rejected for various reasons, chiefly because it showed no significant saving, would preclude inspection of shell required by code, and would greatly increase construction time.

accepted, and before any backfilling could be done or equipment put in place.

More detailed studies then revealed that the use of a single long cylinder would present difficulties which could not be overcome. Further development of the single cylinder design, which brought out the reasons why it was unsuitable, appears in Fig. 3. Note that the reactor is in a "pod" projecting below the bottom of the 50-ft cylinder, in order to bring it below the level of the steam generators, and that the canal rests in a large notch in the top of the cylinder. As the studies progressed, the fact was brought out that with this arrangement the canal could not be placed higher than the reactor, and connected to it by a water-filled tube, because the depth below the water surface would be too great for manipulating apparatus of any practicable design, since such apparatus has to reach down to the core when it is necessary to replace a fuel element. The resulting configuration of the cylinder, with a large notch in it, led to stresses and details in the design of the steel shell at 50 psi which could not be kept within reasonable limits.

The next step was to divide the container into separate but permanently interconnected chambers as shown in Fig. 4. This arrangement permits the canal to be constructed directly on top of the reactor, and the steam generators to be placed a little above the level of the reactor and as close to it as practicable, so that the pipes carrying the "coolant" between the reactor and the steam generators will be as short as possible. This is important, because these pipes are of stainless steel and very costly, and because the larger the volume of "coolant" in the pipes, the larger must be the volume of the container to hold the steam in the event the coolant should be released. With this in mind, the reactor compartment is made as small as possible, and the steam generators are brought as close as possible to the ends of their chambers nearest the reactor.

The next step was to reduce the length of the two steam generator chambers to the practicable minimum as determined by the space requirements of the equipment, and obtain the necessary total volume by constructing an auxiliary chamber alongside, joined to the others by cylindrical tubes of generous size. This leads to a more compact arrangement on the site and provides another chamber close to the reactor chamber which can receive vapor from around the reactor in the event of an "incident," and in which can be installed the pressurizer, safety valves, and other equipment connected



In recent aerial view note that, at top center, supporting structure is partly in place for crane which will run above fuel canal and reactor. Steel-shell containers at each side of reactor are being roofed over, as also is auxiliary chamber this side of them. In foreground, turbine generator building is well along toward completion.

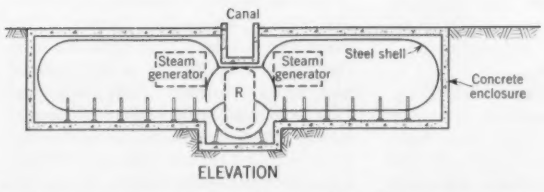


FIG. 3. Preliminary design utilizing single cylinder has notch in top for canal and reactor in "pod" below bottom to bring it below level of steam generators. Resulting configuration of cylinder led to prohibitive stresses and design details.

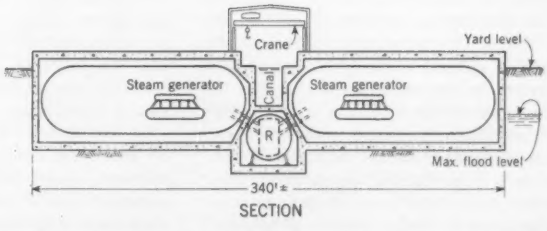


FIG. 4. Next step was to divide container into separate but permanently interconnected chambers. Here canal can be over reactor and steam generators can be as close to it as practicable. Further improvements led to final design, Fig. 5.

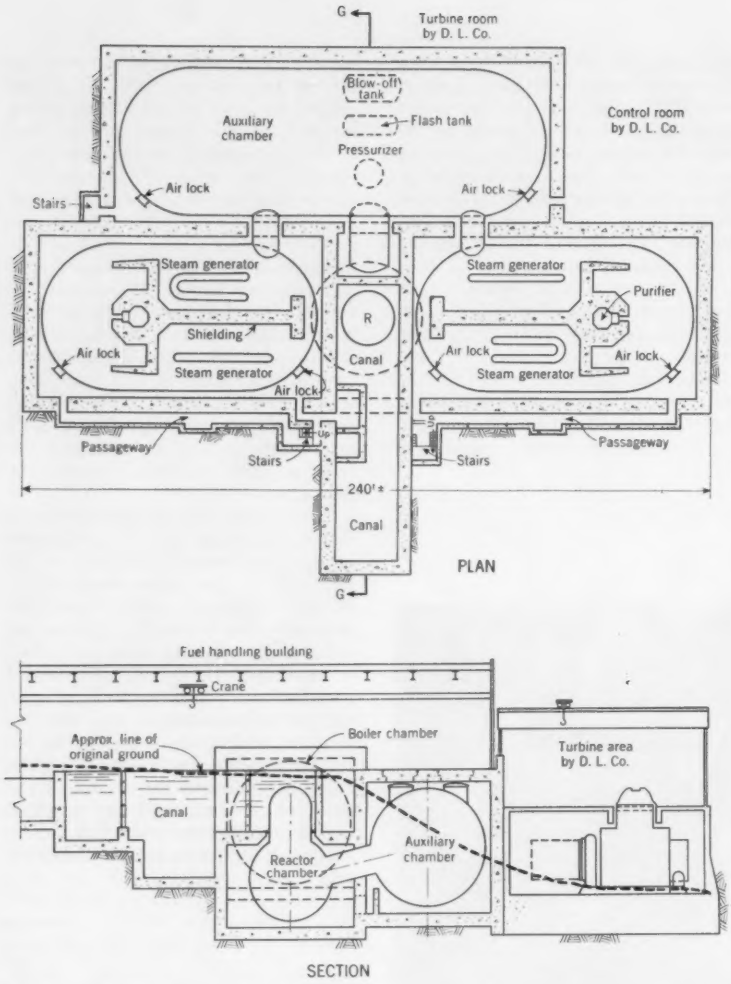


FIG. 5. In adopted design, shown in plan and cross section, steam generator chambers have been made as short as possible and necessary total volume has been provided by addition of auxiliary chamber alongside to receive vapor in event of an "incident." This arrangement is not only more compact but also fits natural contours of site. Steel containers are placed where natural slope of ground is downward, away from reactor.

with the "coolant" system. This layout is shown in the plan of Fig. 5.

These chambers were then related to the natural contours of the site as shown in the cross section of Fig. 5, and the outlines of the concrete enclosure of the container were developed. Each chamber of the container is enclosed in a close-fitting concrete box, with walls and roof decks approximately 5 ft thick. Nearly this thickness was required for shielding, although the structural design governed at most points. The gamma-ray shielding requirement, however, dictated the simple slab design rather than a beam-and-girder design, which might have been considered except for the fact that an inherent feature would have been the use of slabs too thin for adequate shielding.

In addition to the exterior shielding of the container chambers, extensive concrete shield walls have been constructed inside them. Although no operators will be regularly on duty inside the container, and under no circumstances can the large hatchways in the container shell be opened with the plant in operation, it was nevertheless considered essential to make it possible for workers to enter the container through air-locks and to reach certain areas for maintenance purposes. The integrity of the container is protected by air locks at all personnel entrances while people are passing in and out.

The internal shielding makes it possible to reach the demineralizing equipment while the loops are running, and to enter the area around a steam generator which has been shut down and purged of any radioactivity, while its neighbor is still active. Also, in the auxiliary chamber, there are numerous valves which can be reached for servicing if necessary. This internal shielding required approximately 2,500 cu yd of normal concrete, and was a significant item of structural work.

In view of the extensive use of special high-density concrete on some AEC projects, around reactors, it will perhaps be of interest to note that at the Shippingport Atomic Power Station such concrete was nowhere found to be economically justified although it was considered wherever it seemed likely that it might be useful. The shielding inside the container chambers is a case in point. The reduction in volume of this interior concrete which could be obtained by using high-density concrete would make possible a corresponding reduction in the gross volume of the container, with a consequent saving of an appreciable tonnage of container steel. However, estimates showed that this saving would not be enough to balance the higher cost of the high-density concrete.

The concrete boxes of the exterior enclosures of the container chambers were made as watertight as practicable, since, as indicated in the cross section, Fig. 4, the river in flood may rise well above the bottom of the chambers. No attempt was made, however, to achieve absolute watertightness, which would have required a complete membrane enclosure of the entire underground structure. A means of drainage is provided for any minor leakage of ground water or flood water that may occur.

In fitting the plant to the contours of the site, the canal for handling atomic fuel was a determining feature. This canal will be a busy working area during the initial installation of the reactor and again whenever there is a fuel change or core replacement. A special manipulating crane runs on rails at the floor level. A traveling crane of 125-ton capacity runs on rails 41 ft above the normal water surface and also extends over an adjacent railroad spur. Obviously the floor around the canal should be placed at a convenient and accessible

level, and this was established at an elevation 4 ft 6 in. above the finished yard grade. The normal level of the canal water surface was established as 18 in. below the adjacent floor.

The elevation of the reactor was determined by its necessary relationship to the canal, and the elevations of the steam generator chambers on each side were determined by the layout to meet the requirements previously mentioned, of having the steam generators a little above the reactor and as close to it as practicable. This brought the tops of the concrete decks of the enclosures of the steam generator chambers at a height of 14 ft 6 in. above the finished yard grade and 10 ft above the floor adjacent to the canal. The auxiliary chamber was then placed at a level such that the top of the deck over it is flush with the floor adjacent to the canal, thus providing accessibility to that deck for the installation of additional auxiliary equipment and the storage of the many bulky accessories required in connection with fuel handling.

The site plan is so arranged that the steel container chambers are placed where the natural slope of the ground is downward away from the reactor, and the lower position of one of these containers with reference to the others is a logical one with reference to the foundation conditions. The overall arrangement is such that the entire reactor plant rests on good gravel, and no foundation difficulties have been encountered in its construction.

Such is not entirely the case in the adjacent turbine-generator area, which however is the responsibility of the Duquesne Light Company, which designed and constructed the turbogenerator as an entirely separate feature, although closely connected to the reactor plant. Suffice it to say that the reactor plant location was agreed upon by all concerned as being the best spot for it on the site.

An interesting feature of the design of the concrete boxes enclosing the steel container chambers is the method of constructing the roof slabs. These boxes are 55 ft wide and 55 ft high in inside dimensions, each large enough to shelter a five-story building. The top slabs could not be constructed until after the steel shells of the container chambers were completed and tested. Then very little space remained between the tops of the cylindrical portions of the containers and the under sides of the roof slabs. It would have been unduly expensive to make the container steel strong enough to support the forms plus the weight of the wet concrete when these slabs were poured, and the removal of forms from inside the completed structure would have been difficult and hence costly.

The procedure followed to overcome this difficulty is shown in Fig. 6. The stiffener rings on the container were found to be adequate to support the roof forms for a distance of 11 ft out from the walls on each side, leaving 33 ft in the center of the slab to be constructed without posting down to the container. Precast slabs 2 ft thick, 4 ft wide, and 33 ft long, were constructed and lowered into place to fill this gap. These precast units were strong enough to support the wet concrete for the remaining thickness of the roof deck, and were designed so as to be bonded and anchored to the layer of poured concrete above them. The bottom reinforcement in the precast slabs serves as the bottom reinforcement for the completed slabs. There were, however, some areas in which the precast slabs could not be used, namely, the areas around the openings in the roof decks above the hatches in the container. The concrete framing around these openings was poured in place, with forms supported from above.

Another interesting feature of the construction of the reactor plant is the placing of the foundations for adjacent buildings on compacted backfill of considerable depth. With the bottom of the concrete slab under the reactor coming at a depth of 68 ft 6 in. below finished yard grade, and the bottoms of the slabs under the boiler chambers at a depth of 52 ft 6 in., it would be unduly expensive to sheet the entire depth of the excavation. Steel sheeting was therefore used up to a distance of 36 ft 6 in. below the finished yard grade, and above that an open excavation with sloping sides was used. The ground was such that if undisturbed it would stand on a slope of nearly 45 deg, but even so, with this depth of excavation and an allowance for working space for construction of the walls of the concrete enclosure, there was necessarily a large open area around the enclosure which would have to be backfilled to depths up to 36 ft.

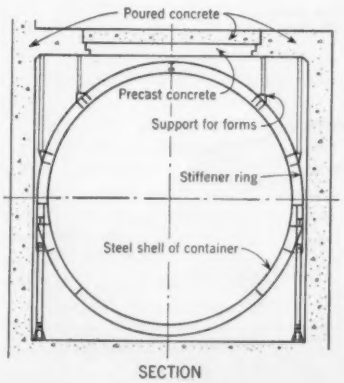


FIG. 6. Section through a steel shell shows how tops of concrete boxes enclosing all three steel-sheell containers were designed to avoid supporting formwork and wet concrete on top center of shell. (See also photo on cover.)

Several service buildings are required for the operation of the reactor, housing miscellaneous auxiliary equipment, laboratories, fuel storage, washrooms, and other facilities. These buildings are placed as close to the reactor plant as practicable, with the result that some of their foundations come in the area of the deep backfill. The original ground consisted of well graded gravel with some silt content. The excavated material was stockpiled and used for backfill, or equal or better gravel was obtained from other sources and used for backfil'. The density of the undisturbed soil at the bottom of the excavation was measured in several places. Then the backfill was placed with exceptional care in 6-in. layers, thoroughly rolled and tamped, and brought to a density equal to that of the densest undisturbed ground beneath, as shown by the tests.

The backfill density was carefully checked by tests made at frequent intervals during placing. The density tests were made in accordance with the specifications of the American Association of State Highway Officials. Backfill thus compacted was considered equal to the original ground in so far as the support of the foundations for the buildings was concerned. The foundations resting on compacted backfill were designed the same as the foundations resting on undisturbed soil.

The steel container, which was fabricated and erected by the Pittsburgh-Des Moines Steel Company, required approximately 2,200 tons of steel and the concrete enclosure and fuel-handling canal required approximately 24,000 cu yd of concrete and 2,600 tons of reinforcement. The excavation for this part of the work totaled approximately 90,000 cu yd, and the backfill around the concrete enclosure required approximately 50,000 cu yd.

These are the high points of the structural design and show the strong influence of structural and architectural considerations on the plant layout. The details of the design and construction of the steel container and of the concrete enclosure of the container could each be made the subject of another article. The reactor plant buildings are of conventional construction designed with the object of keeping the cost as low as possible.

WILLIAM A. CONWELL, M. ASCE

Structural Engineer, Duquesne Light Company, Pittsburgh, Pa.

Foundation and structural

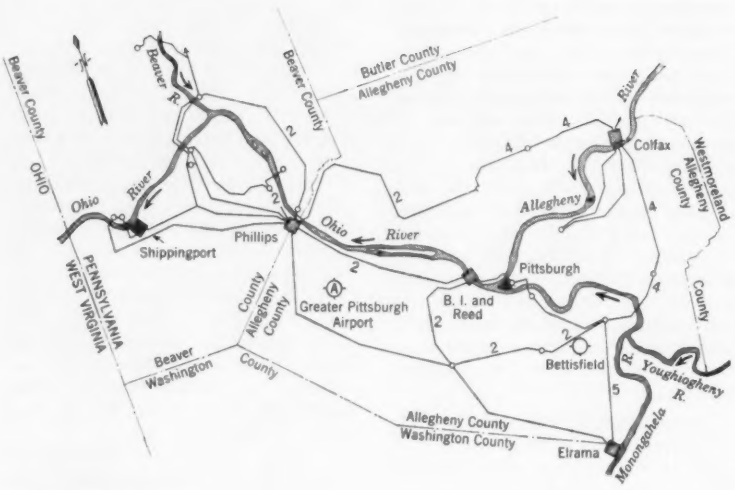


FIG. 1. Shippingport Atomic Power Station is situated on Ohio River about 25 miles downstream from Pittsburgh. Other Duquesne Light Company generating stations are shown as well as company's whole transmission net.

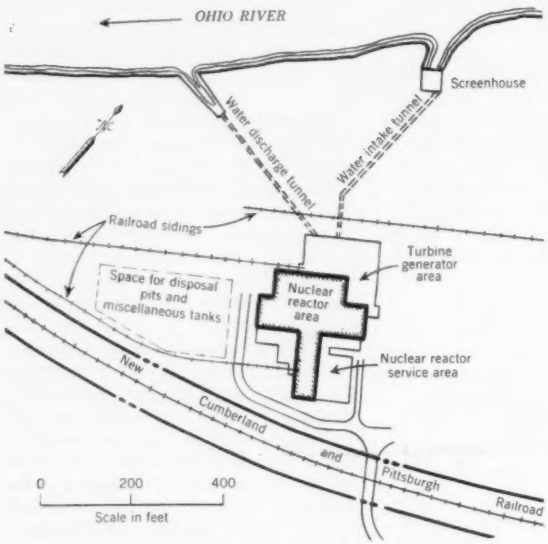


FIG. 2. Station is divided into two main parts—nuclear reactor area and turbine-generator area. Duquesne Light Company is designing and building turbine-generator section here described. Other section, described in preceding article by Mr. Evans, is being constructed for AEC by Westinghouse Electric Corp. and Duquesne Light Co., with Stone & Webster as architect engineers.

The agreement between the Atomic Energy Commission and the Duquesne Light Company for construction of the Shippingport Atomic Power Station was entered into on March 18, 1954. The company agreed to furnish the site, construct the turbine-generator part of the station, contribute $5,000,000 toward the development and construction of the nuclear part of the station, operate and maintain the entire station, and reimburse the AEC for steam delivered at the throttle of the turbine. The capability of the turbine generator is to be 100,000 kw, and electrical energy is to be transmitted at 138,000 volts into the present 1,204,000-kw system of the Duquesne Light Company.

Shippingport Atomic Power Station is located on the south bank of the Ohio River about 25 miles northwest (downstream) of Pittsburgh. This station is shown in Fig. 1 together with the other major generating stations of the Duquesne Light Company system—Brunot Island and Reed, Colfax, Elrama, and Phillips, and the transmission ring connecting them.

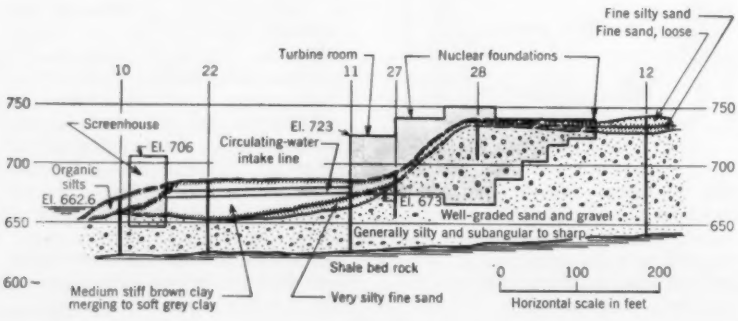
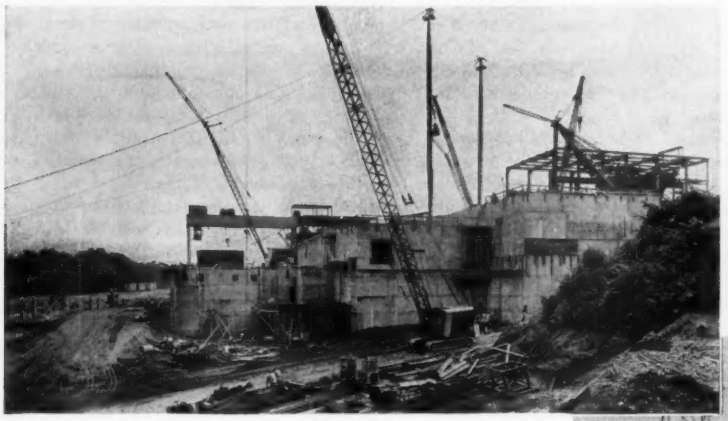


FIG. 3. Station structures are supported generally on well graded sand and gravel lying above shale bedrock.

features of turbine-generator plant



Turbine-generator section of atomic power plant is to left in progress photo taken in summer of 1956. Above deck at left, 75-ton gantry crane erects condenser. On deck is large crane used to feed construction materials to nuclear part of plant at right. Just below this crane, near concrete foundation wall, transformer foundations are being built. Ohio River is to left. In right foreground, foundations for railroad trestle are under way.

From switchyard, current will flow at 138,000 volts into transmission circuit of Duquesne Light Co. Reactor station is under construction at far left.

The principal part of the station lies between the New Cumberland and Pittsburgh Railroad and the Ohio River, as shown in Fig. 2. Also shown in this figure are the location of the screenhouse, the circulating water intake and discharge tunnels, and the ultimate layout of railroad sidings which will serve the various levels of the station.

Foundation conditions

Topography and soil formations at the site appear in Fig. 3. The normal pool of the Ohio River at Shippingport is 662.6 ft above sea level. The ground slopes gradually upward from this elevation to a fairly level area at about El. 685. At the south end of the level area a sharp bank rises up to another level area at about El. 735. This area extends to the south several hundred feet until it meets the rising hills which have their top elevations at about El. 1135.

The oldest geologic stratum at the site is the shale bedrock, which slopes upward from about El. 620 at the river's edge to El. 640. Well-graded sand and gravel apparently were deposited on the rock to about El. 730, and subsequently eroded in places to elevations as low as 655, and the clay then deposited to about El. 685. The organic silts near the river were placed after the erosion of the clays in recent geologic time.

The shaded area of Fig. 3 outlines the approximate location of the principal foundations. The well-graded sand and gravel was considered suitable bearing material, and there were no major foundation problems for the nuclear structures founded on this material. There were, however, problems induced by the construction procedures required by an accelerated schedule. The screenhouse is also founded in the sand and gravel formation. The turbine room and circulating water lines, however, required special treatment.

Flood factors considered

Table I shows actual and estimated elevations of flood waters for the most severe floods. It is evident that, even with the reduction in elevation effected by the flood reservoirs, the level area of the property at El. 685 will be periodically flooded. This was an important factor in determining the arrangement of facilities. A flood height of El. 706 was adopted for design purposes. The Standard Design Flood developed by the Pittsburgh District, Corps of Engineers, Department of the Army, was considered in arriving at this design flood elevation. With the variation of estimated reduction in flood-water elevation depending on the type of flood indicated by Table I, it seemed unwise to rely on the full 12-ft reduction estimated for the Standard Design Flood.

Economics and small likelihood of occurrence precluded the adoption of

TABLE I. Flood Data

For Ohio River at Shippingport Atomic Power Station—normal pool, El. 662.6

	Unreduced Flood El.	Est. Reduction, All Reservoirs in Operation	Fully Reduced Flood El.
1936 flood	703.0*	10.1	692.9
1942 flood	701.5†	6.4	695.1†
1954 flood	702.0	9.0	693.0*
Standard design flood	712.5	12.0	700.5

* Recorded elevations.
† Estimated because reservoir system was partially in operation for 1942 flood.

the unreduced elevation of 712.5. The adopted elevation, 706, represents a partially reduced elevation of the Standard Design Flood. At the same time it conforms to the practice of the Duquesne Light Company of using a flood design elevation of 3 ft above the 1936 flood for major power stations. This El. 706 determined the elevation of the top of the screenhouse, the elevation of the fill placed north of the turbine-generator area, and the magnitude of the forces used in determining the strength of the structures and their resistance to uplift.

Structural features

In Fig. 4 is shown a cross section through the plant. Because the existing material at El. 673 was not suitable for the support of the turbine generator slab, it was removed and replaced with select compacted sand and gravel obtained principally from the excavation for the nuclear structures. The turbine-room foundation is a concrete slab 10 ft thick, topped by 2 ft of concrete in which pipe trenches and drains are located. The thickness of slab was determined on the basis of equating its weight, and the dead load immediately above it, to the hydrostatic pressure that would occur with flood water at El. 706. Not only was a factor of safety against flotation thus provided but the deformation of the slab with variations in hydrostatic pressure was minimized.

The walls, designed as cantilevers, are generally 5 ft thick at the base and 2 ft thick at the deck—at El. 723. The concrete deck, $8^1/_2$ in. thick, is designed for a live load of 500 psf. No general waterproofing is being applied to the deck, but sealer material has been applied at junctures between steel and concrete and at other points where leakage might occur. Where some leakage is expected, a system of drains has been designed to intercept it immediately below the deck and conduct it to the station drainage system.

Steel columns and beams support the deck and lower floors, the beams being generally pocketed in the concrete walls. To provide the desired separation between the turbine-generator and the nuclear sections of the station, a line of steel columns supported by the foundation slab was placed along the southern side of the turbine room. The railroad track along the south side of the deck is directly supported by beams at that level. The turbine generator is supported independently by a heavy plate and angle box-column and girder structure filled with concrete. The considerably greater width of support required by the turbine as compared with the generator posed special problems in design.

Because of the unrestricted view required in the control room, there are no interior columns. Fabricated girders span the room from north to south and support the interior columns of the floors above.

Intermediate floors in the turbine areas are either of grating or 5-in. concrete slab. The grating is used generally around auxiliary mechanical equipment, the slab in the vicinity of electrical equipment such as switchgear requiring a good rolling surface and mounting channels embedded in concrete to accurate dimensions.

At certain locations, such as points where the main steam and other lines emerge from the nuclear part of the plant, nuclear radiation shielding is provided, consisting usually of conventional concrete 3 ft thick supported by the steel framing.

The outdoor turbine area is to be serviced by a gantry crane of 75-ton capacity. The long north or "toggle" leg of the crane is supported on the foundation wall of the north turbine room. The short south leg is carried by a crane girder north of the turbine generator service building, and by the concrete enclosure wall of the nuclear part of the plant west of the turbine-generator service building.

The turbine-generator service building, shown in Fig. 4, houses the control room for the entire station as well as the usual administrative facilities. No special treatment of the foundation soils was required inasmuch as the foundation slab was founded on the sand and gravel stratum. The main section of the foundation wall on the east side is cantilevered from the slab and is 6 ft 9 in. thick at the bottom, 2 ft thick at the top. Along the south side of the building and part of the east side, it was possible to span the wall horizontally and use a thinner section.

The foundation slab is the floor for the storage section of the building. Floors for locker room, relay room, and control room are 5-in. concrete slabs. The upper floors, devoted to offices, conference room, and first-aid room, are of prefabricated metal construction with concrete surface. The structural members of the roof are also of prefabricated metal. Interior and exterior walls of the building are concrete block. A shielding problem was posed by an exit from the nuclear part of the plant at El. 696 but this was again solved by supporting a concrete shield on the steel framing.

The main transformers and towers carrying the lines to the switchyard are supported on fill, the top of which is at El. 706, north of the turbine room, as shown in Fig. 4. Because no significant settlement of the transformers could be tolerated, their foundations were placed on the same select fill as the turbine room. Removal of clay for this foundation required excavation to El. 656 ±. A line of well points was used to lower the water table, allow excavation to the sand and gravel stratum, and permit controlled placing of the select fill. Clay was not removed under the area of the tower foundations. The slight tower settlement expected when the clay is compressed by the overlying fill was considered acceptable.

In the area around the turbine room the following items were also founded on select fill: (1) station service transformers, (2) the boiler required for building heat at times when the reactor is not in operation, (3) the emergency diesel generator intended to provide power in the event of a failure of other sources when the reactor is not operating, and (4) the water treating equipment east of the turbine area. Miscellaneous tanks, roads, and other items that would not be critically affected by small settlements, are founded on compacted fill overlying clay.

A plan and section of the screenhouse appear in Fig. 5. Economy dictated a position south of the usual river bank location, and the resulting intake channel from the river. Since the structure is founded on sand and gravel, the soil conditions offered no problem. Piling for the construction cofferdam was however driven to rock. Then the foundation slab was poured against it and the piling left in place as a precaution against erosion. An underdrainage system with a central sump made it possible to pour the foundation slab in the dry. The walls, floors, and deck are of concrete construction. A 10-ton gantry crane is provided for removal of equipment through hatches in the deck for

maintenance. Because the area around the screenhouse will be inundated in time of flood, a footbridge is being built from the filled area north of the turbine room to the screenhouse. This bridge also carries electrical conduits.

Problems encountered in the design of the circulating-water lines are partially indicated in Fig. 5. A poured concrete transition section merges the lines from each of the two pumps into a single tunnel with walls 2 ft thick and inside dimensions of 6 ft 6 in. X 6 ft 6 in. It was essential to prevent differential settlement between the poured concrete transition section of the circulating-water tunnel and the screenhouse. Since the latter is founded on sand and gravel, it was decided to support the circulating-water intake line on the same material. This was most economically accomplished by use of steel H-piling driven into the sand and gravel.

At the turbine-room end of the tunnel, piling was not required as it and the turbine-room slab are founded on the same select fill (Fig. 4). North of the select fill, however, the line enters the clay layer overlain with compacted fill. Since the fill will compress the clay and possibly cause settlement of foundations supported by it, it was decided to use poured concrete for this section of the line and to found it on steel H-piles driven into the sand and gravel. Between the poured concrete sections adjacent to the screenhouse and the turbine room, the circulating-water intake line is reinforced concrete pipe of 84-in. diameter supported by clay. The weight of this section of line is approximately the weight of the clay it displaces so no significant settlement is expected. The circulating-water discharge line encounters conditions similar to those of the intake line and is therefore partially of poured concrete and partially of concrete pipe.

The switchyard or transmission substation is located south of Railroad. Cumberland and Pittsburgh the New It serves to connect the Shippingport Atomic Power Station to the Duquesne Light Company transmission system. This location placed it in an area where the soil characteristics were determined by outwash from the high hills immediately to the south. The conditions were therefore different from those previously discussed. Because of the light loads involved in these structures, it was possible to limit bearing pressures to 1 ton per sq ft and thus keep any settlement that may occur within the required tolerance. The foundations are of concrete and the superstructure of galvanized steel.

Permanent roads and railroads, the site drainage system, and other similar items are considered to be within the turbine generator part of the station, and are therefore a Duquesne Light Company responsibility. Of interest is the fact that all concrete for the turbine generator part of the station contained fly ash as an aggregate.

The scale of the turbine generator part of the project is indicated by the following quantities:

Structural steel	1,400 tons
Reinforced concrete	20,000 cu yd
Reinforcing steel	1,300 tons
Excavation and grading	300,000 cu yd
Backfill	120,000 cu yd

All work on the turbine-generator part of the station is being directed by the Engineering and Construction Division of the Duquesne Light Company. The Stone and Webster Engineering Corporation of Boston, Mass., served as consultants on soil and foundation conditions. Close cooperation has been maintained with the Pittsburgh Area Office of the U. S. Atomic Energy Commission and also with the prime contractor for the nuclear part of the power station, the Atomic Power Division of the Westinghouse Electric Corporation.

FIG. 4. Section through turbine-generator part of plant shows arrangement, structural features.

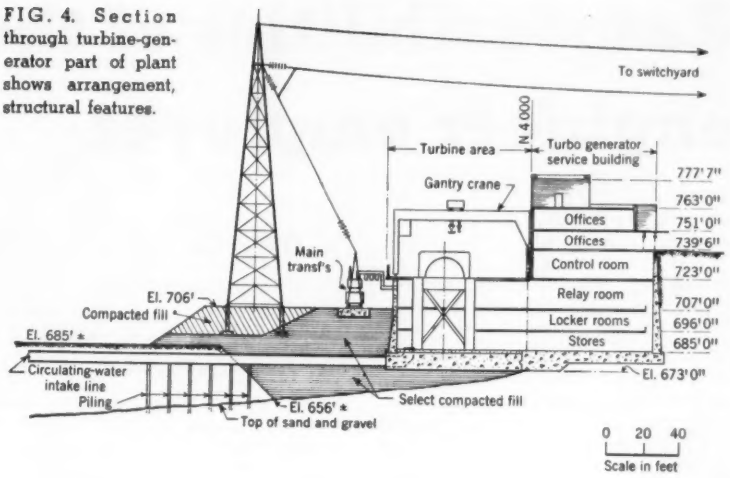
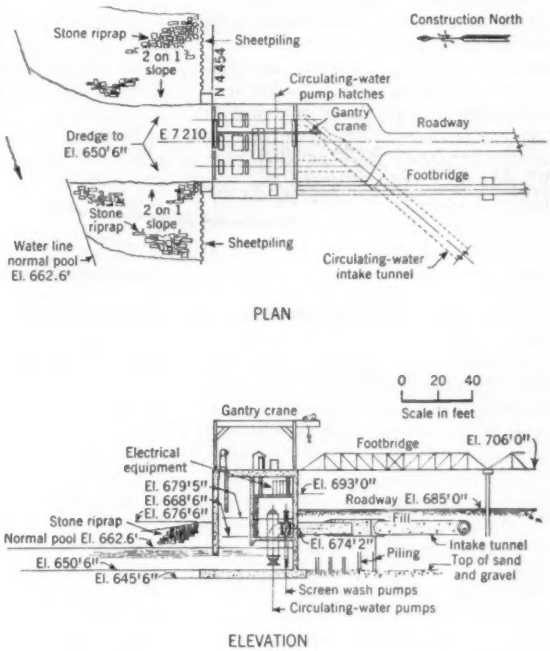


FIG. 5. Screenhouse at river's edge is connected to plant by concrete pipe of 7-ft diameter carrying circulating water.



Responsibilities of the engineer employer

Views of an employer in public service

HARRY WIERSEMA, M. ASCE

Assistant to the Chief Engineer, Tennessee Valley Authority, Knoxville, Tenn.

Forty years ago the relationship between employer and employee aroused little comment. Perhaps this was because organizations then were much smaller than they are now, and the relationship between employer and employee was more personal than can possibly exist in a large organization today. Those relationships were very satisfactory. They stimulated the younger engineer to advance in his profession.

Under conditions where such intimate relationships prevailed, matters such as salary and conditions of work were subordinate. Fifty dollars a month for a graduate was considered adequate, if not munificent, and for field work, hours running from sunup to sundown seven days a week, with very few holidays, were matters of course. Vacations and other privileges were not even given a thought. When, with the advent of structural steel workers on one of my early jobs, our hours of work were suddenly cut down to eight a day, the sobering thought occurred to me that I owed this new-found leisure to the success of the A. F. of L. steel workers in bargaining for the eight-hour day.

It is a far cry from the personal relationships that then existed in small organizations to the relationships existing today in a large engineering organization such as the TVA, which at its peak had about four thousand engineering employees scattered over several states on ten to fifteen projects. When this organization started to grow, in the mid-1930's, it was my practice to interview each new employee, usually a technical graduate from one of our large universities, for at least 15 minutes when he reported for work. When employees arrived by the dozen, I found that even this minimum contact was no longer possible to maintain. Under such conditions, relationships between employer and employee must become matters of rules and regulations. Such rules today are far more liberal to the employee than anyone ever dreamed of 30 or 40 years ago. This is true not only in large governmental organizations but also in the most progressive private organizations. Let me outline some of the more desirable conditions of employment and relationships between management and employer—most of which conform to TVA practice today.

Salaries

In our capitalistic economy, salaries are indeed important. They are a measure of achievement. It is generally agreed that employers should pay salaries commensurate with those paid for similar work elsewhere, especially within the immediate area. It is not so well established, however, that because of the professional status of the engineer, employers should pay salaries above those of the rank and file. This is particularly true on construction work. It is discouraging for engineers who have spent years in obtaining a technical education and other years in gaining experience and engineering proficiency to find that workmen under their supervision with no college education or engineering training receive hourly pay which adds up to almost the same as theirs. This is a problem difficult to solve, but one which employers should tackle.

Also it is important that employers should base salaries on the professional proficiency required to hold down the job, rather than on the production of the employee, as would be the case with factory workers. Some system should be inaugurated to review salaries periodically to see that they remain in line with the general advance in the profession. A system to provide for a periodic review of performance, job evaluation, and prompt promotion to higher positions as soon as earned, is of utmost importance.

Conditions of employment

In addition to salaries, many other conditions of employment are important, and employers should adopt generous provisions for vacation and sick leave. Job stability is another responsibility of the employer. Regulations should be set up to insure that, in the event of a reduction in personnel, the employee will be treated fairly, with due regard to his period of service and his ability to perform the work remaining to be done. Provisions should be made for the retirement of older employees on the basis of an employer-employee joint contribution to a fund to supplement federal Social Security. In all large organizations, a hospitalization plan, to which both employer and employee contribute, is one of the requisites.

Regular channels for presentation of grievances must be provided. In TVA, the existence of such machinery, although seldom used by engineers, has been an effective morale builder. Even in large organizations, where size makes definite rules and regulations necessary, it is the responsibility of the employer to make sure that these rules are applied fairly and equitably, and that professional relationships are maintained at the highest level.

Communication

One of the most important factors in producing high morale is that of communication. Every employer should devise means, such as discussion groups, conferences, bulletins, or other media, to acquaint his employees with the activities of the organization and the changing policies and events that affect his life so materially. This is the more important in that it encourages the employee to identify himself with

the organization and with his job. Effective communication, by developing a sense of real participation, leads to more loyal and effective cooperation in the common objectives of efficient production.

Professional status

There are other obligations of employers which are peculiar to the engineering profession. It is most discouraging for a professional man to be assigned duties at a subprofessional level. Employers should have routine and monotonous subprofessional work performed by engineering aides or draftsmen. Since engineering employees must keep abreast of their profession, the employer should provide for the circulation of technical publications and for library facilities to assist employees in keeping up with technical advances. Opportunities should be provided for design engineers to make inspection trips to construction projects to observe the work they have designed, and in this way to get a sense of continuity in their work. Opportunities should be provided for employees to attend professional meetings. They should be encouraged to join the technical societies of their specialty, and to take advantage of available educational facilities that will advance them in their profession.

Young engineers should be encouraged to register for professional practice in the state in which they work. Employers on federal public works should themselves be registered engineers even though this may not be required by law. Most essential of all, the engineering employer owes it to his engineering employees to take them into his confidence on the more important activities of the organization so that they can consider themselves an integral part of the organization. It is in this way that they can be trained for management, can feel that their opinions are valued, and can hope some day to step up to higher places in the organization.

Collective bargaining

One more employer responsibility which I believe to be important is that of bargaining collectively with employees through the media of unions of their choice. Since this subject of collective bargaining is controversial, I want it understood that the views here expressed are my own and are not necessarily those of the organization to which I belong. The employer should not merely tolerate bargaining groups as a necessary evil but should cooperate wholeheartedly with such organizations in an attempt to achieve the best results for all concerned.

Such improvement in working conditions as has come to engineers over the past 40 years has been a result of the general improvement throughout all industry. This in turn has been brought about largely by the efforts of organized labor. But the engineer has lagged behind other elements of our economic system both in salaries and in working conditions.

In spite of all that engineers and their professional societies have done to improve the economic status of engineers, the fact remains that their salaries are still disappointingly low as compared with those in other fields. Only in the starting rate offered to new engineering graduates—as a result of intense competition due to their small numbers—has there been an improvement commensurate with the responsibilities of the profession. Salaries of graduates with several years of experience are still but little higher than those of recent graduates. The fact that 40,000 engineers have seen fit to join employee organizations with the objective of bargaining collectively is an indication of the growing dissatisfaction of the employee engineer with his economic status.

Recognition of this situation inspired some action by the Founder Societies a few years ago, but this action was ineffective and short-lived. It began in 1943 when the ASCE Board of Direction authorized the establishment of local committees to act as bargaining agents for professional engineers. This activity developed into a defensive move to keep engineers out of labor organizations and did little more. Since the passage of the Taft Hartley Act to succeed the Wagner Act, practically all activity in this field has subsided.

In 1937 TVA engineer employees started an organization of their own called the Tennessee Valley Authority Engineers Association (TVAEA) and succeeded in building up a large membership. Later, about 1943, the TVAEA joined with other unions, some national in scope, to form a bargaining panel which was recognized by TVA as representing all employees in Grade 7 (carrying a salary of $7,500) and below—the dividing line established between management and employees. In 1955 TVAES saw fit to join the Engineers and Scientists of America (ESA), a national body organized along labor union lines.

There has been no perceptible difference in the operation of TVAEA since it affiliated with ESA. For the past 13 years this organization of TVA engineers has bargained collectively with TVA management with regard to salaries and conditions of work. Far from affecting the professional status of these engineers, this organization seems to have developed a quality of leadership in those actively engaged in its work, including collective bargaining, that has served them well in their professional work.

In many respects the activities of employees in bargaining with management in TVA have been beneficial to all concerned. Three examples will be cited as representative of these activities and benefits.

1. When TVA first became an employing organization, the federal work schedule of 39 hours, 7 on week days and 4 on Saturday, was adopted. Employee organizations suggested to management that they would be willing to add one more hour to their work week in return for the elimination of Saturday work. This was accepted by management, and a work week of five 8-hour days was adopted to the satisfaction of both, and with a definite increase in efficiency.

2. Under the TVA Act, employees were excluded from the Civil Service Retirement System. Sixteen years ago employees petitioned management to set up an independent retirement system to which they would contribute one-half the cost. This resulted in an eminently successful system managed by a board of seven directors, three chosen from management and three elected by employees, the seventh member being chosen by the other six.

3. In 1956 employee unions bargained with management for a hospitalization plan to which both employees and management would contribute on a 50–50 basis. A joint union-management committee studied possible plans, as a result of which an outstanding health and medical plan was adopted.

It is noteworthy that during the 16 years I served as the seventh member of the Retirement Board, and also during the time I served on the Joint Union-Management Hospitalization Committee, there was never an instance of employees and employers lining up against each other. On the contrary, both employee and employer members have always acted as individuals and exercised individual judgment instead of adhering to views dictated by class loyalty.

Conclusions

From 13 years of experience in collective bargaining with employees in TVA, and from observation of the experience of others, I have come to certain conclusions on this subject.

1. The ASCE and other professional societies have had little influence on employee relationships, and this little has had small effect in raising the economic status of engineers.

2. The growing size of engineer organizations has so changed the relationship between the employer and the younger engineers, that the employer no longer has the personal contact necessary for complete understanding. Because of this lack of personal influence, younger engineers in increasing numbers have joined unions with the hope of material benefit.

3. Such unions have helped to increase the salaries of engineers and to raise their economic status.

4. There is not necessarily any irreconcilable conflict between the professional status of engineers and the efforts of unions to improve their economic status.

Whether we like it or not, we are going to see more, rather than less, unionization of engineers in the coming years. The merger of the CIO and A. F. of L. will undoubtedly stimulate an effort to get white collar workers, including engineers, into recognized, organized unions. Until the economic status of the engineer is raised to the point where he no longer feels the necessity of union with his fellows to accomplish his aims, we will undoubtedly be faced with union activities within the profession.

Just as defensive unionization was ineffective in keeping engineers out of unions in the past, so will any amount of persuasion and discouragement of unionization be ineffective in the future. Instead of worrying about employee unions, the employer should be working for better economic status for his employees not only to improve morale, reduce turnover, and secure better working conditions, but more important, to raise the standard of the entire profession in the eyes of the non-engineering world.

What about the responsibilities and obligations of the employee to the employer? As a result of my experience with younger engineers, I am certain that they will respond to the efforts of their employers to improve their professional status and will react to encouragement in a very satisfactory way. We can count on our young engineers to develop professionally in response to the efforts of employers to help them, and they will adequately train themselves to some day take the place of their elders in this honorable profession.

(This article is based on a Knoxville Convention paper presented by Mr. Wiersema as part of the panel discussion on Responsibilities of the Engineering Employer and Employee to Each Other, before the session sponsored by ASCE's Department of Conditions of Practice, presided over by Vice President Frank L. Weaver. Another article from this panel discussion is scheduled for an early issue.)

THE READERS WRITE

Short-cut to plotting parabolas

TO THE EDITOR: The so-called short-cut to plotting an ordinary parabola presented by C. F. Ende, M. ASCE, in the June issue (p. 67) and the method of plotting a cubic parabola presented by A. J. Ashdown in the August issue (p. 65) involve graphical steps that may not be remembered.

Rewriting Mr. Ende's Eq. 4 (June issue, p. 67), we have

$$y = \left(\frac{x}{a}\right)^2 c \quad \ldots \ldots (1)$$

This equation expresses the familiar parabolic law—that the ordinates vary as the square of the abscissas—which is all we need to know, as will now be indicated.

Dividing the semi-span a (in Mr. Ende's Fig. 1) into any number of equal parts, say five, and letting y_1, y_2, y_3, etc., equal the ordinates at these points of division, we have

$$y_1 = \left(\frac{1}{5}\right)^2 c = \frac{1}{25}\,c;\quad y_2 = \frac{4}{25}\,c$$

$$y_3 = \frac{9}{25}\,c;\quad y_4 = \frac{16}{25}\,c;\quad y_5 = \frac{25}{25}\,c = c$$

Plotting these points (preferably on coordinate paper), establishes the curve in a very simple manner.

Now, rewriting Mr. Ashdown's Eq. 1 (August issue, p. 65), we have

$$M_x = \frac{1}{3}\,Px\left[1 - \left(\frac{x}{l}\right)^2\right]. \quad \ldots (2)$$

Dividing the span into any number of equal parts, say five, the corresponding ordinates, M_1, M_2, M_3, etc., are easily calculated, as will be shown by the following example.

Let $l = 30$ ft and $P = 3{,}000$ lb. Then with $x_1 = {}^1/_5\,l = 6$ ft; $x_2 = {}^2/_5\,l = 12$ ft; etc., we get

$$M_1 = 6{,}000\left(1 - \frac{1}{25}\right) = 5{,}760 \text{ ft-lb}$$

$$M_2 = 12{,}000\left(1 - \frac{4}{25}\right) = 10{,}080 \text{ ft-lb}$$

$$M_3 = 18{,}000\left(1 - \frac{9}{25}\right) = 11{,}520 \text{ ft-lb}$$

$$M_4 = 24{,}000\left(1 - \frac{16}{25}\right) = 8{,}640 \text{ ft-lb}$$

$$M_5 = 30{,}000 \times 0 = 0$$

In addition, the absolutely maximum ordinate should be plotted. This maximum ordinate occurs when $x = \frac{1}{\sqrt{3}}\,l = 0.577l = 0.577 \times 30 = 17.31$ ft, for which

$$M_{max} = 17{,}310\left(1 - \frac{1}{3}\right) = 11{,}540 \text{ ft-lb}.$$

Plotting these points and connecting them with a French curve gives the desired cubic parabola.

T. F. HICKERSON, M. ASCE
Formerly Prof. of Civil Eng.
Univ. of North Carolina
Chapel Hill., N C.

Professional engineers do not "bid" on projects

TO THE EDITOR: With considerable surprise, I read the small article which appears on page 84 of CIVIL ENGINEERING for August. This article has to do with the expansion of Jidda Port, a project soon to be undertaken by the Government of Saudi Arabia.

The brief article urges that qualified engineers may wish to send representatives to the area to study the project in the event that "an opportunity to bid" should occur. This notice is obviously contrary to the basic concept of ethical practice which our committee has been seeking to implant firmly in the minds of all members of the ASCE.

H. C. GEE, M. ASCE,
Vice Chairman, ASCE Committee on Professional Practice
Gee & Jenson, Inc.
West Palm Beach, Fla.

[The Vice-Chairman of the Society's Committee on Professional Practice is quite right.—EDITOR]

U.S.G.S. Water Supply papers available

TO THE EDITOR: For many years I have been carrying in my office library a bound set of U.S. Geological Survey Water Supply Papers from No. 1 to No. 720, and another bound set of the Survey's Bulletins from No. 1 to No. 856, both of which are complete and in good order as far as they go. As my practice no longer involves the use of these books, I wish to dispose of them to some interested civil engineer on mutually acceptable terms.

GORDON R. WEST, M. ASCE
Consulting Engineer
3722 Main St.
Houston 2, Tex.

SOCIETY NEWS

Nine New Offfcers to Be Inducted at Annual Convention

Highlights in the Careers of Our New Officers

Mason G. Lockwood

Taking office in October as 88th President of the Society is Mason G. Lockwood, well known Texas consultant and member of the Houston firm of Lockwood, Andrews & Newnam. A Member of the Society since 1941, Mr. Lockwood recently completed a two-year term as Vice-President for Zone IV. His committee work has included the chairmanship of the Committee on Conditions of Practice and membership on the Committee on Technical Sessions and the AIA-ASCE Cooperative Committee. His long service in the Texas Section includes terms as director, vice-president, and president.

A native Texan, Mr. Lockwood attended high school at Taylor and Collinsville, Tex., graduating from the latter in 1919. Fascinated from the first by civil engineering work, especially construction, he favored summer jobs in the construction field—anything from water boy for a construction gang to mule skinner. He drove a Fresno team doing grading work and later a dump wagon hauling hot-mix asphalt for street paving. He studied at Austin College for three years, his studies there being interrupted by two years of teaching in country schools, and then transferred to Rice Institute, from which he received the B.S. degree in electrical engineering in 1927.

For eight years following his graduation he was with the Houston Lighting & Power Co. and its affiliates on construction work and as office engineer, handling special assignments and engineering investigations. In March 1935, with J. R. Dowdell and William M. Andrews, Mr. Lockwood established the firm of Dowdell, Lockwood & Andrews. Upon withdrawal of Mr. Dowdell in 1936, the firm name was changed to Lockwood & Andrews. Frank H. Newnam, Jr., became a partner in 1946, and the name of the firm was changed to Lockwood, Andrews & Newnam in 1956. In early 1956 the firm moved its headquarters office from downtown Houston to 1010 Waugh Drive, some three miles from the business district, where it had built a modern office building designed exclusively for its own use. Permanent offices are also maintained in Corpus Christi and Victoria, Tex.

MASON G. LOCKWOOD
President-elect of ASCE

With a wide practice in civil, structural and industrial engineering, the firm has been closely identified in recent years with many important industrial and public works developments, especially in the Gulf Coast region of Texas. These include harbor works, large-scale water supply developments, earthworks, roads and streets, airports, industrial plants, buildings, incinerators, power plants, pipelines, air conditioning and electrical systems. During the war and since, the firm has also participated in the design and supervision of construction of many military establishments for the Army, Navy and Air Force both in the United States and overseas. These have included airfields, ordnance depots, fueling facilities, wharves, docks, and industrial plants for the manufacture of ordnance materials.

Mr. Lockwood has a wide interest in civic affairs, and has been especially prominent on public committees dealing with the water needs of his area. He has served on the board of governors of Rice Institute and has devoted much time to its building problems. He is equally devoted to the welfare of the University of Houston and gives an increasing amount of time to its activities. His hobbies include hunting, fishing, and in recent years golf. He says that he is probably the worst golfer in Houston, knows that he will never improve, but probably enjoys the game more than the best golfer in Houston.

Francis S. Friel

Francis S. Friel, who will be new ASCE Vice-President for Zone II, is president of the Philadelphia consulting firm of Albright & Friel, specialists in water supply and purification projects, sewage treatment works, refuse collection and incineration projects, industrial waste disposal, power plants, dams and other fields. He has been in the consulting field for 34 years—for 25 years as a member of Albright & Friel, in charge of all engineering and management. His long career has been interrupted only by service in the Army Corps of Engineers in World War I. He was with the 304th Engineers in France, and is now a major in the Engineers Reserve. In World War II his firm designed and built the Aberdeen (Md.) Proving Grounds and various military airports and Army and Navy projects.

A 1916 graduate of Drexel Institute of Technology, Mr. Friel received the honorary degree of doctor of engineering there in 1949 and the Alumni Award for Distinguished Service in Engineering in 1950. He is currently a member of the Drexel Board of Trustees and chairman of its

FRANCIS S. FRIEL
Vice-President, Zone II

NORMAN R. MOORE
Vice-President, Zone III

CLINTON D. HANOVER, JR.
Director, District 1

Building and Fund Raising Committees. In 1948 Mr. Friel was awarded the medal of the American Public Works Association, and in 1956 he was designated Philadelphia's "Engineer of the Year" by the local engineering societies.

Becoming an Associate Member of ASCE in 1921 and Member in 1926, Mr. Friel served as Director from 1950 through 1953. In addition, he has served on eight Society committees. Active also in the Philadelphia Section, he has been a director and vice-president, and was president for two terms. His numerous other affiliations include the American Institute of Consulting Engineers, the Federation of Sewage and Industrial Wastes Associations, and the Pennsylvania Sewage Works Association, all of which he has served as president. He is chairman of the U. S. Executive Committee of the International Congress on Large Dams and member of the U. S. Executive Committee of the World Power Congress, and has represented the United States at many international meetings and congresses.

Norman R. Moore

Norman R. Moore, new Vice-President for Zone III and a prominent civilian employee of the Army Corps of Engineers, has since 1949 been chief of the Engineering Division of the Mississippi River Commission and Lower Mississippi Valley Division at Vicksburg, Miss. His initial experience with the Corps was on design and construction of the Muskingum dams in Ohio. Later he was responsible for design of the Yazoo Basin dams in the Vicksburg District. During the early war years, he also had charge of planning and designing the large military construction program of the Vicksburg District. An alumnus of the University of Minnesota, Mr. Moore spent his first years following graduation in the fields of railroad and highway engineering, and on flood control studies with a consulting engineer.

Mr. Moore has been a Member of ASCE since 1938. Long prominent in Mid-South Section affairs, he assisted in organizing its Jackson and Vicksburg Branches. As ASCE Director from 1951 to 1953, he planned formation of the District 14 Council. He is active in Vicksburg civic affairs affecting municipal improvements.

Clinton D. Hanover, Jr.

The new Director for District 1 is Clinton D. Hanover, Jr., a partner in the firm of Hardesty & Hanover, New York City consulting engineers. Mr. Hanover's 34-year professional career has been chiefly concerned with the design and construction of bridges. Upon graduation from Yale University in 1922 with the degree of B.S., *magna cum laude*, he entered the office of E. W. Wiggin, a consulting engineer of New Haven, Conn. In 1924 Mr. Hanover went to New York to work for J. A. L. Waddell (later the firm of Waddell & Hardesty), with whom he was associated with one interruption until 1935, when he left to work as engineer for the Taylor-Fichter Steel Construction Co. on the construction of the Triborough Bridge lift span. In 1936, he became an engineer in the New York City Department of Public Works, and in 1939 chief of the Bureau of Bridge Design for that department. In 1945 Mr. Hanover left the department to enter into partnership with Shortridge Hardesty as Hardesty & Hanover, successor to the firm of Waddell & Hardesty.

Mr. Hanover is inventor of the Hanover Skew Bascule Bridge, a movable bridge designed for the economical crossing of waterways on the skew. One of these bridges received both an American Institute of Steel Construction Award and the Silver Medal of Honor for Engineering from the Architectural League of New York in 1954.

Mr. Hanover joined ASCE in 1923 as a Junior Member, became an Associate Member in 1930, and a Member in 1940. He is also a member of American Institute of Consulting Engineers, which he has served as secretary, vice-president, and member of council; a director of the Yale Engineering Association; and a member of the American Bridge, Tunnel and Turnpike Association, the American Railway Engineering Association, and the Municipal Engineers of the City of New York.

E. Leland Durkee

E. Leland Durkee, engineer of erection for the Bethlehem Steel Co., Bethlehem, Pa., and new Director for District 4, has been in charge of the erection of steel bridges and other structures all over the world. He is a graduate of Worcester Polytechnic Institute, from which he received the B.S. degree in 1919 and the C.E. degree in 1924 and an honorary engineering doctorate in 1946.

Mr. Durkee was with the McClintic-Marshall Company from 1919 to 1931, and since the latter year has been with Bethlehem Steel. His assignments with these companies have included design of bridges for the Pittsburgh, Pa., Engineering Department; engineer of erection on the Outerbridge Crossing between New Jersey and Staten Island; engineer of erection on the Cooper River Bridge in Charleston, S.C.; resident engineer in charge of erection of the Mississippi River Bridge at Baton Rouge, La.; resident engineer in charge of erection of the Rainbow Bridge at Niagara Falls, N. Y.; resident engineer on erection of the new Pecos River Bridge in Texas; and head of the special squad that planned erection methods and designed the erection equipment for the Chesapeake Bay Bridge. Currently he is in charge of the erection scheme for the new Mississippi River Bridge at New Orleans, the longest cantilever span in this country and the third

E. LELAND DURKEE
Director, District 4

HOWARD F. PECKWORTH
Director, District 8

FINLEY B. LAVERTY
Director, District 11

longest in the world. For a CIVIL ENGINEERING article on "Erection Methods on the Baton Rouge Bridge" he was awarded the ASCE Construction Prize in 1941.

Becoming an Associate Member of the Society in 1926 and Member in 1929, Mr. Durkee has been active in the Lehigh Valley Section, which he served as president in 1949.

Howard F. Peckworth

The new Society Director for District 8 is Howard F. Peckworth, one-time member of the ASCE headquarters staff. Since 1945 Mr. Peckworth has been managing director of the American Concrete Pipe Association, with offices in Chicago. He is also managing director of the American Concrete Pressure Pipe Association, Concrete Pipe Associations, Inc., and the American Concrete Agricultural Pipe Association. His home is in Batavia, Ill.

Mr. Peckworth was educated at Cornell University and Princeton University, graduating from the latter in 1926 with the B.S. in engineering. In his early career Mr. Peckworth worked on construction of the Eighth Avenue Subway in New York. He has also been field engineer for the Frederick Snare Corp. on construction of the Tygart River Reservoir, 1934 to 1936; resident engineer in charge of construction of Inland Dam for the Alabama Industrial Water Supply Commission, 1936 to 1938; construction plant designer for Pacific Constructors, Inc., on construction or Shasta Dam, 1938 and 1939; and senior engineer on the $60,000,000 Santee-Cooper Navigation and Hydroelectric Project, 1939 to 1941. Before going to Chicago in 1945, he was editor of CIVIL ENGINEERING for a year and Assistant to the Secretary of ASCE for three years.

Joining the Society as a Junior Member in 1927, Mr. Peckworth became an Associate Member in 1931 and a Member in 1937. His many committee assignments in the Society have included chairmanship for three years of the ASCE Committee on General Arrangements for the 1952 Centennial of Engineering. During the year of the Centennial celebration he was president of the Illinois Section, which he has also served as secretary and vice-president. Mr. Peckworth is similarly active on the committees of numerous other organizations, especially those of the American Concrete Institute. Publications to his credit include several volumes on concrete pipe and a booklet, "The Engineer and Collective Bargaining," prepared for ASCE.

Finley B. Laverty

Finley B. Laverty, elected to the Board from District 11, has devoted most of his professional career to hydraulics, hydrology, and the maintenance and operation of flood-control works. He has been chief hydraulic engineer of the Los Angeles County Flood Control District since 1934. In addition to his activities for the District, he has been engaged in the design and construction of dams, major buildings, and hydroelectric plants, and in consulting on flood control and water conservation projects. His accomplishments include research and publications in the realm of water conservation. He was one of the authors of the ASCE Hydrology Manual.

Mr. Laverty has been chairman of a majority of the standing committees of the Los Angeles Section and its Sanitary Group. He was vice-president of the Section in 1947, and president in 1951. He has also been active in the Los Angeles Council of Engineering Societies and in the formation of the Los Angeles Technical Societies Council, and in engineering manpower and education affairs of the Los Angeles area.

At the national level of ASCE, Mr. Laverty has been chairman of the Local Qualifications, Student Chapters, Hydrology, and the Sessions Program for Conditions of Practice Committees; a member of the Committee on Sedimentation; and is currently vice-chairman of the Committee on Junior Members. He is a graduate of Occidental College and Massachusetts Institute of Technology.

William J. Hedley

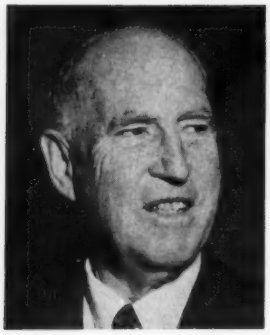
The new Director for District 14 is William J. Hedley, assistant chief engineer of the Wabash Railroad, St. Louis, and a resident of Clayton, Mo. A native of St. Louis County, Mr. Hedley obtained his high school education in Springfield, Mo. In 1925 he graduated from Washington University with the degree of bachelor of science in civil engineering, and in 1953 he received the professional degree of civil engineer from that institution. After a brief period with the Mississippi Valley Structural Steel Co., he began his career in the engineering department of the Wabash Railroad, which he has served as draftsman, bridge inspector, resident engineer, bridge designer, assistant engineer and construction engineer. He has been assistant chief engineer since 1945.

Mr. Hedley was admitted to membership in ASCE in 1939. He is a past-president of the St. Louis Section, has been a contact member for the Student Chapter at Washington University, and was a member of the Advisory Committee on Exhibits for the Centennial of Engineering. He is past-president of the Engineers' Club of St. Louis, the Joint Council of the Associated Engineering Societies of St. Louis, and the Mississippi Valley Maintenance of Way Club. His other affiliations include the Missouri Society of Professional Engineers, the American Railway Bridge and Building Association, and the American Road Builders Association. He is also a member of the Committee on Grade Crossing Protection and the Committee on Waterway Projects of the Association of American Railroads.

Currently Mr. Hedley is president of the American Railway Engineering Associa-

WILLIAM J. HEDLEY
Director, District 14

RANDLE B. ALEXANDER
Director, District 15



GEORGE W. BURPEE
Hon. M. ASCE

tion, chairman of the Engineering Division of the Association of American Railroads, and president of the Alumni of the School of Engineering of Washington University. He is the author of several treatises on railway-highway grade crossing protection which have received wide recognition.

Randle B. Alexander

District 15 will send to the new Board of Direction Randle B. Alexander, a specialist in bridge design and construction and bridge engineer for the Texas State Highway Department at Austin. A native Texan, Mr. Alexander was graduated from Trinity University in 1919, after interruption of his education by service in World War I. His technical training was obtained at the University of Michigan.

Becoming a bridge designer for the Texas Highway Department in 1922, Mr. Alexander has been continuously with the department since that time, with the exception of a year with a bridge consulting firm in Kansas City and three years with the Navy Seabees in World War II. For some years his duties were largely in the field, supervising the construction of large river bridges. He was appointed bridge engineer in 1948.

Mr. Alexander became an Associate Member of ASCE in 1939 and a Member in 1954. Long active in the Texas Section, he served it as president in 1954.

ASCE Presents Honorary Membership to Five of Its Members

Five new Honorary Members—elected by the Board of Direction at its Knoxville meeting and announced in the July issue—are being inducted into the Society at the forthcoming Annual Convention in Pittsburgh. Presentation of their awards will be a feature of the Wednesday luncheon meeting on October 17.

A wide range of important engineering work and professional attainment is represented in the careers of the five engineers who are receiving the Society's highest honor. Some of the professional highlights in their lives follow.

George W. Burpee

George W. Burpee, newly elected Honorary Member, has long been eminent in the field of transportation, including railroad engineering, rapid transit and bridges and express highways. After receiving his A.B. degree from Bowdoin College and his B.S. from Massachusetts Institute of Technology, the latter in 1906, he started his engineering career as a draftsman in the office of the chief engineer of the Louisville & Nashville Railroad.

The next year found him in responsible charge as field engineer, valuation engineer, and industrial appraiser with Westinghouse, Church, Kerr & Co., thus beginning a connection that lasted almost continuously until 1920. Among his assignments was that of resident engineer in charge of the construction of the U. S. Nitrate Plant at Muscle Shoals, Ala.

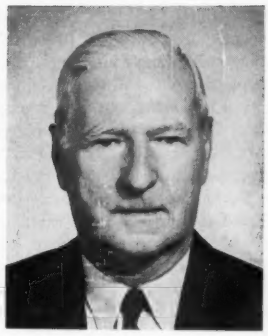
In 1921 he went with Coverdale & Colpitts, consulting engineers of New York, N. Y., a connection that has continued to the present time. Since 1924 he has been a partner, and he is now senior partner. His responsibilities with that firm have included the valuation of railways and industrial properties, examination of businesses from the engineering viewpoint, and numerous engineering studies. Such studies have been made for railroad consolidations and reorganizations, for mass rapid transit facilities, and for estimates of traffic and revenue for more than 200 revenue projects, including bridges and express highways. Another project was the construction of the Basic Magnesium Plant at Henderson, Nev.

In connection with his numerous industrial interests he has served as president of the General Aniline & Film Corp. and is now a director of the Chase-Manhattan Bank, New York; the Brooklyn Union Gas Co.; the Kaiser Steel Corp., California; the Lukens Steel Co., Pennsylvania; the National Vulcanized Fibre Co., Delaware; and the Tennessee, Alabama & Georgia Railway Co., of which he is also secretary. He is a member of the Board of Engineering Consultants for the Port of New York Authority and a member of the National Panel of Arbitrators of the American Arbitration Association.

His professional connections include membership in the Engineering Institute of Canada, the American Railway Engineering Association, and the American Institute of Consulting Engineers, of which he was president in 1934–1935. In our own Society, he has served as Director, 1942–1944, and Vice-President, 1952–1953.

His civic-mindedness is attested by membership in a number of local organizations in Bronxville, N. Y., where he makes his home. These organizations have included the Board of Education, the Board of Zoning Appeals, the Planning Commission, and the Board of Governors of Lawrence Hospital. For his college, Bowdoin, from which he received the honorary de-

ALBERT HAERTLEIN
Hon. M. ASCE



THOMAS M. ROBINS
Hon. M. ASCE

gree of doctor of science in 1939, he serves on the Board of Trustees and was chairman of the building committee for the Gibson Hall of Music completed last year.

Albert Haertlein

Except for five years in engineering practice, new Honorary Member Albert Haertlein has devoted his life to the teaching of civil engineering at Harvard University. Along with his distinguished career as an engineering educator, he has combined a lively and continuing interest in professional problems, including the registration of engineers.

He received the B.A. degree from Harvard College and B.S. degrees in civil engineering from both Massachusetts Institute of Technology and Harvard University. He is a member of Phi Beta Kappa, Tau Beta Pi, and Sigma Xi. He had a part in the first World War as a first lieutenant in the U. S. Army in 1918 and 1919.

Albert Haertlein, now Associate Dean of Engineering and Applied Physics at Harvard University, and Gordon McKay Professor of Civil Engineering at the same institution, is widely known in the practice of professional engineering as well as in the teaching field. In particular, he has dedicated himself to maintaining high standards for the profession, both as a teacher and in efforts to advance registration.

Dean Haertlein has been a hard-working member of the Massachusetts Board of Professional Engineers and Land Surveyors since the formation of that agency in 1942. His work on the board has included examination of the careers of some 10,000 applicants for registration as engineers. While on the ASCE Board of Direction, he served on the Committee on Application Classification, and there too examined the careers of engineers—in this case to determine their qualification for membership in a professional society.

His service to the Society has included a term as Director, 1946–1948, and one as Vice-President, 1950–1951. His devotion to the Society and the profession has also manifested itself in service on numerous committees.

In the Boston Society of Civil Engineers he has been a director, vice-president, and president. He is also a member of the Engineering Societies of New England (of which he was president 1945–1947), the American Society for Testing Materials, the American Society for Engineering Education, the American Association for the Advancement of Science, the American Railway Engineering Association, the American Road Builders Association, the American Welding Society, and the American Concrete Institute.

Thomas M. Robins

Nationally prominent as an engineer officer, Maj. Gen. Thomas M. Robins was the active executive agent in supervising and stimulating the largest civil engineering force that has ever been assembled under one control. An Assistant to the Chief of Engineers, U.S. Army, from 1939 to 1945, his many abilities found full scope. The many works, civil and military, for which he had primary responsibility, would make his name known everywhere if he were a person given to self advertising.

This new Honorary Member of ASCE was born at Snow Hill, Md., in 1881. Appointed to West Point from that state in 1900, he graduated in 1904. In the early part of his career he served abroad twice—in Cuba during the winter of 1908–1909 and in the Philippines from 1909 to 1912. For a time he was in immediate charge of construction of the fortification on El Fraile Island—Fort Drum—which gave the Japanese so much trouble in 1942 and us so much in 1945.

On his return from the Philippines in 1912, he served his first tour of duty in the Office of the Chief of Engineers. During World War I he was engineer officer to the New York Port of Embarkation and later was port storage officer, in which post he showed the executive ability and administrative force that served him in such good stead during World War II. For his work in this capacity he received the Distinguished Service Medal before he was forty.

Between the two wars, General Robins performed most of the varied duties of an engineer officer of his seniority. He was district engineer at Providence and New London, assistant professor at West Point, student officer at Fort Leavenworth and the War College, and served two more tours of duty in the Office of the Chief of Engineers in Washington, D. C.

He became division engineer at San Francisco in 1929, and when the Pacific Division was split into two parts he went to Portland, Ore. There he supervised an enormous amount of engineering work, including construction of Bonneville Dam. From 1938 to 1939 he was commandant of the Engineer School at Fort Belvoir, Va. On September 1, 1939, he was promoted to Brigadier General and moved—for the last time—to the Office of the Chief of Engineers. He remained there, as Assistant to the Chief of Engineers, until his retirement in November 1945. He had been made a Major General in 1942.

Since his retirement General Robins has had a successful engineering practice in Portland, Ore., an area to which he became devoted during his tour of duty in the Northwest.

Ole Singstad

For more than forty years Ole Singstad has been a leader in tunnel design, construction and operation. Born in Norway, this new Honorary Member came to the United States in 1905, shortly after graduating from Trondheim Polytechnic Institute. He became a United States citizen in 1911.

Mr. Singstad's interest in tunnels was not long in showing itself. By 1919 he was engineer of design on the Holland Tunnel under the Hudson, a pioneer ven-

© Blackstone Studios

OLE SINGSTAD
Hon. M. ASCE

ture in vehicular tunnel construction. Later he became chief engineer and superintendent on this $48,500,000 project. As a consulting engineer in the decade from 1925 to 1935, his leadership in the development of the modern vehicular tunnel became manifest. His projects included the George A. Posey Tube in California; the Detroit-Windsor Tunnel; the Lincoln Tunnel and the approaches to the George Washington Bridge in New York; vehicular and pedestrian tunnels under the Scheldt River at Antwerp, Belgium; the Squirrel Hill Tunnel in Pittsburgh; the Broadway Tunnel in San Francisco; and the Pasadena Tunnel in Texas.

As chief engineer of the New York Tunnel Authority for the next ten years, Mr. Singstad's responsibilities included the $55,000,000 Queens-Midtown Tunnel under the East River and the $80,000,000 Brooklyn-Battery Tunnel under New York Harbor.

Now a member of the New York consulting firm of Singstad & Baillie, Mr. Singstad is currently engaged on the $50,000,000 Baltimore (Md.) Harbor Tunnel. His firm has also been active in subway work, grade-crossing eliminations, highway improvement and parking garage projects, and investigations, plans, estimates, and reports on many proposed tunnel and subway projects here and abroad.

Mr. Singstad has long been active in the Society. As a Director, 1930–1933, he was a member of the Publications Committee at the time CIVIL ENGINEERING was started. He is a former president of the Metropolitan Section and has been active on many Local Section and Society committees. In 1945 he was awarded the James Laurie Prize.

He is also a member of a number of other engineering and scientific societies, and the recipient of honorary degrees from New York University, Stevens Institute of Technology, St. Olaf College, Newark College of Engineering, and the Polytechnic Institute of Brooklyn. In addition, Mr. Singstad is a Decorated Officer, Order of the Crown, Belgium, and Knight First Class, Royal Norwegian Order of St. Olav. In 1944 he received the Abraham Lincoln Award for distinguished services on behalf of the City of New York. He is a member of Sigma Xi, Tau Beta Pi, and Chi Epsilon, and of the Royal Norwegian Academy of Sciences, and an Honorary Member of the Harvard Engineering Society, the John Ericsson Society, and the International Mark Twain Society.

Mr. Singstad has also assumed important public responsibilities, including service with the Technical Board of Review of the Federal Emergency Administration of Public Works, the New York City Emergency Relief Administration, and the National Research Council. He is a member of the Board of Directors of the American Standards Association and of the Advisory Council of the Princeton University Department of Engineering. He is also a lecturer on engineering problems at New York and Harvard universities and has published many papers dealing with engineering and transportation.

RALPH B. WILEY
Hon. M. ASCE

Ralph B. Wiley

An eminent engineering educator, Honorary Member Ralph B. Wiley has also given important aid to a number of Mid-Western cities in carrying out their water and sewage-treatment programs. He received the degree of B.S. in civil engineering from the University of Michigan in 1906, and two years later, in 1908, made two connections that were to have long-range consequences. He joined the faculty of Purdue University, and he became a Junior Member of ASCE.

He began his long and fruitful connection with Purdue as an instructor in hydraulics, became associate professor of sanitary engineering in 1917 and professor of sanitary engineering in 1919. After serving as acting head of the School of Civil Engineering on five different occasions, he was made its head in 1937. In 1944 he was appointed head of the School of Civil Engineering and Engineering Mechanics, and held this position also until his retirement in 1954. Under the leadership of Professor Wiley the civil engineering and engineering mechanics departments at Purdue expanded phenomenally. In 1937 the staff totaled only 18; by 1952 it had reached 108.

Despite the claims of Professor Wiley's busy career as a teacher, he also accomplished an unusual amount of engineering work outside college walls. As sanitary engineer for the City of Detroit for some fifteen summers, he designed the $50,000,000 Connors Creek Sewer and backwater gate, with a capacity of 6,000 cfs, as well as the Fox Creek and other important sewers. For three summers, he was with Pearse, Greeley & Hansen on sewage treatment projects for Illinois cities. Since his retirement from Purdue in 1954 he has been serving part-time as construction consultant for the Indiana Division of Mental Health in accelerating its building program.

The other connection formed by Professor Wiley in 1908, that with ASCE also led to a long period of service to the profession. He helped to organize the Indiana Section in 1932, and has since served it as vice-president and president. In 1950 he assisted in the organization of the District 9 Council. As Director from District 9, 1941–1943, and as Vice President from Zone III, 1947–1949, Professor Wiley held many assignments on ASCE committees. Naturally he has been much interested in the affairs of Student Chapters, particularly those in Indiana. Many other technical societies have benefited from his interest—among them the American Water Works Association, the American Society for Engineering Education, the Indiana Academy of Science, the American Public Health Association, the Indiana Society of Professional Engineers, Tau Beta Pi, and Sigma Xi. The Indiana Sewage Works Association has honored him with its distinguished service award. In 1955 he was selected as Engineer of the Year for Indiana by the State Section of the National Society of Professional Engineers.

Professor Wiley's record in public service is outstanding. From 1943 to 1954 he was on the Indiana Stream Pollution Control Board, as chairman after 1945. He served an equally long term on the Indiana Flood Control and Water Resources Commission.

ASCE Prizes to Be Awarded During Convention

Once again the Society is bestowing prizes and awards for Transactions papers deemed especially important. With the exception of the Construction Engineering Prize, which traditionally goes to an especially meritorious CIVIL ENGINEERING article, this year's awards honor papers appearing in Volume 120 of Transactions. The awards were announced by the Board of Direction at its Knoxville meeting and, with one exception, they will be presented at the Wednesday morning ceremonies during the Pittsburgh Convention. The exception is the J. C. Stevens Award, which was presented to the winner, Serge Leliavsky, M. ASCE, on September 14, at a meeting of the Institution of Civil Engineers of Great Britain. This year first awards are being made of two new Society prizes, which commemorate the achievements of the late Past-President Ernest E. Howard and the late Thomas A. Middlebrooks.

Norman Medal

This year the Norman Medal, oldest and most coveted of the Society's awards, goes to Carl E. Kindsvater, M. ASCE, and Rolland W. Carter, A.M. ASCE, for their paper on "Tranquil Flow Through Open-Channel Constrictions." Professor Kindsvater is no stranger to Society awards, having won the Collingwood Prize in his Junior Member days and the James W. Rickey Medal last year. Since 1945 he has been on the staff of the School of Civil Engineering at Georgia Institute of Technology, where he now holds the title of Regent's Professor of Civil Engineering. Since 1951 he has been a consultant to the U. S. Geological Survey and director of the hydraulic research projects which that agency has conducted in the Georgia Tech Laboratory. For the past fifteen years Mr. Carter has been employed by the Surface Water Branch of the U. S. Geological Survey in Alabama, Georgia, Kansas, and Washington, D. C., where he is currently located as chief of the Research Section. He is the author of numerous papers and reports in the field of hydraulics and hydrology.

J. James Croes Medal

There were three collaborators on the paper on "Fatigue in Riveted and Bolted Single-Lap Joints," which has been awarded the J. James R. Croes Medal, second of the Society's awards in point of distinction. They are Jack W. Carter, A.M. ASCE, Kenneth Lenzen, A.M. ASCE, and Lawrence T. Wyly, M. ASCE. Mr. Carter has a background of teaching and research work at Purdue University. Since January 1953 he has been with the Glenn L. Martin Co., Baltimore, Md., as design engineer, and recently was promoted to chief of the product design staff. Mr. Lenzen has done research for the Portland Cement Association and taught at Northwestern and Purdue universities. Since September 1955 he has been associate professor of applied mechanics at the University of Kansas. Professor Wyly has a background of eighteen years on the design and construction of railway and highway bridges. He has been teaching since 1938 and is currently professor of civil engineering at Northwestern University. All three have many published papers to their credit.

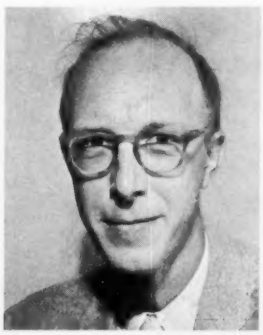
Thomas Fitch Rowland Prize

ASCE Honorary Member Jonathan Jones, of Bethlehem, Pa., receives another Society honor with the award to him of the Thomas Fitch Rowland Prize for his paper entitled "Erection of Main River Span, Passaic River Bridge." As chief engineer of fabricated steel construction for the Bethlehem Steel Co. for many years and as contributor to numerous research groups, Mr. Jones has made practical application of research advances in the structural field in erecting some of the country's most notable bridges

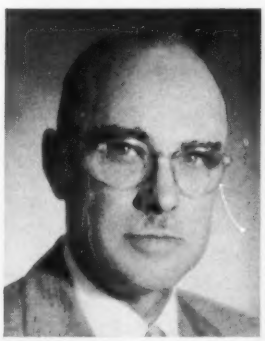
CARL E. KINDSVATER

ROLLAND W. CARTER
Co-winners of Norman Medal

JACK W. CARTER



KENNETH H. LENZEN
Co-winners of J. James R. Croes Medal



LAWRENCE T. WYLY

JONATHAN JONES
Thomas Fitch Rowland Prize

SAMUEL I. ZACK
James Laurie Prize

ROBERT HORONJEFF

JOHN HUGH JONES

Co-winners of Arthur M. Wellington Prize

and buildings. The Golden Gate Bridge is only one of many famous structures fabricated and erected during his tenure with Bethlehem Steel.

James Laurie Prize

Samuel I. Zack, M. ASCE, who will receive the James Laurie Prize for a paper on "Financing of Sewage Works in Pennsylvania," is a partner in the Harrisburg, Pa., consulting firm of Gannett Fleming Corddry & Carpenter, which he is also serving as chief of the Sanitary Division. Author of numerous articles on sewage and industrial waste treatment, Mr. Zack holds the Kenneth Allen Memorial Award from the New York State Sewage Works Association for a paper on sludge experiments at Chicago's North Side Treatment Works.

Arthur M. Wellington Prize

Two members of the University of California engineering staff—Robert Horonjeff and John Hugh Jones, Associate Members of the Society—had a hand in the paper on "Determination of Radii of Curvature of Taxiways," which is being awarded the Arthur M. Wellington Prize. In the Corps of Engineers from 1936 to 1950, Robert Horonjeff was in charge during the war of all airport planning and design in the San Francisco District of the Corps. Since 1950 he has been at the University of California, where he is professor of transportation engineering and research engineer in the Institute of Transportation and Traffic Engineering. Mr. Jones is assistant professor of civil engineering at the University of California, with which he has been connected since 1947. As a member of a Joint Fact-Finding Committee on Highways, he has also served as consultant to the California Legislature on study and analysis of the state's highway needs.

Collingwood Prize for Junior Members

John H. Schmertmann, J.M. ASCE, winner of the Collingwood Prize for Junior Members for a paper on "The Undisturbed Consolidation Behavior of Clay," joined the University of Florida faculty this fall as assistant professor of civil engineering and research professor at the Engineering and Industrial Experiment Station there. He has just completed a two-year tour of duty for the Army, which was spent in Greenland and at the Corps of Engineers' Snow, Ice & Permafrost Research Establishment at Wilmette, Ill.

Rudolph Hering Medal

Thomas R. Camp, M. ASCE, who will receive the Rudolph Hering Medal for his paper, "Flocculation and Flocculation Basins," is senior partner in the Boston consulting firm of Camp, Dresser & McKee, and a former professor of sanitary engineering at Massachusetts Institute of Technology. His authorship of technical and scientific papers in his field has brought him seven previous prizes—three of them ASCE awards.

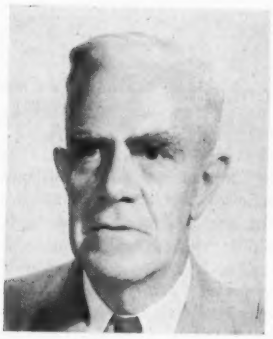
Leon S. Moisseiff Award

The Leon S. Moisseiff Award for an important paper in the field of structural design goes to George S. Vincent, M. ASCE, for a paper on "Aerodynamic Stability of Suspension Bridges." A veteran of many years service in the Bureau of Public Roads, Mr. Vincent has been in Washington, D. C., for the past two years as bridge engineer in the Physical Research Branch. For some years he was with the Bureau in Seattle, involved with the Washington Toll Bridge Authority and the University of Washington on their aerodynamic research on the Tacoma Narrows and other suspension bridge projects. He is currently engaged in several lines of bridge

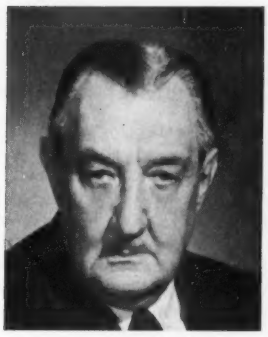
JOHN H. SCHMERTMANN
Collingwood Prize for Juniors

THOMAS R. CAMP
Rudolph Hering Medal

GEORGE S. VINCENT
Leon S. Moisseiff Award



ADOLF A. MEYER
James W. Rickey Medal



SERGE LELIAVSKY
J. C. Stevens Award

RALPH E. BOECK
Ernest E. Howard Medal

research, with special attention to the effects of dynamic loading on highway bridges.

James W. Rickey Medal

Adolf A. Meyer, M. ASCE, an engineer of wide experience in hydroelectric and steam-plant work, will receive the James W. Rickey Medal for a paper on "Modernization of the Hales Bar Plant." He became connected with the Tennessee Valley Authority in 1936, and from 1936 to 1955 was in charge of civil engineering design for all the major TVA projects. Last year Mr. Meyer joined Gibbs & Hill, Inc., for an assignment as chief design engineer for the Cauca River Corporation in Colombia.

J. C. Stevens Award

The J. C. Stevens Award honors an especially important discussion of a Transactions paper. Serge Leliavsky, M. ASCE, consulting engineer of Cairo, Egypt, is this year's winner for his discussion of the paper, "Design of Stable Channels." An emigré from Russia in 1920, Mr. Leliavsky was in the Egyptian Ministry of Public Works, the Ministry of Communications, and the Egyptian State Railways for a number of years. He was engaged on increasing the height of the Aswan Dam and other important projects. He retired from Egyptian Government service in 1951, and since then has been in private practice in Cairo. Mr. Leliavsky has already received his award which was presented by special arrangement with the Institution of Civil Engineers of Great Britain at a luncheon meeting held in London on September 14.

Middlebrooks Award

The Middlebrooks Award, which is being made for the first time this year, goes to Allen J. Curtis and Frank E. Richart, Jr., A.M. ASCE, for their paper entitled, "Photoelastic Analogy for Non-Homogeneous Foundations." Since 1952 Mr. Curtis has been engaged on shock and vibration research and analysis in airborne fire control systems, missiles, and helicopters at the Hughes Aircraft Company, and since 1953 he has also lectured in engineering at the University of California. Frank E. Richart, Jr., is currently professor of civil engineering at the University of Florida, where he is primarily concerned with studies of foundation structures and theoretical soil mechanics. He holds a Ph.D. degree from the University of Illinois, and has taught in the Harvard University Graduate School for four years.

Ernest E. Howard Medal

The first Ernest E. Howard medalist, Prof. Ralph E. Boeck, M. ASCE, has for some years been on the structural engineering staff at Marquette University. Before joining the Marquette faculty, Professor Boeck was for 14 years a civil engineer for the Worden Allen Co., Milwaukee. This newly established award will be made annually to a member of ASCE who has made a definite contribution to the advancement of structural engineering.

Construction Engineering Prize

In a different category also is the Construction Engineering Prize, which is awarded for the best original scientific or educational article on construction printed in CIVIL ENGINEERING. This year's winner, Arve S. Wikstrom, A.M. ASCE, is honored for an article in the December 1955 issue, entitled "Contractor Finds St. Lawrence Bridge Substructure No Picnic." As president of A. S. Wikstrom, Inc., Skaneateles, N. Y., for the past twenty years, Mr. Wikstrom has been engaged as a contractor on many important heavy construction projects in the East.

ALLEN J. CURTIS

FRANK E. RICHART, JR.

Co-winners of Middlebrooks Award

ARVE S. WIKSTROM
Construction Engineering Prize

Construction Division News

Committee on Cold Weather Construction Organized

At its first meeting in New York, the Construction Division's new Committee on Cold Weather Construction organized and planned a program to "coordinate, collect and facilitate the distribution of knowledge essential to engineering and construction in areas of cold weather." The committee's interest centers in regions where permafrost is a problem. Six areas of interest have been defined by the committee. They are differences in cold area environmental disciplines, site, soil, subsurface conditions, climate and weather, exposure and logistic considerations; differences between Arctic and Antarctic conditions; behavior of manufactured and natural materials in extreme ranges of temperature (110 deg F to −85 deg F); heat transfer; equipment applications and operations under conditions existing in cold weather regions; and determination of need for research and recommended action.

The work of the committee will be apportioned among task forces whose purpose will be to study specific problems or subjects in major areas of interest, build up a bibliography of available information, outline the information needed and report back to the committee. As they complete this work, these task forces will be dissolved. Four such task forces are in the process of being organized. They deal with Construction and Engineering; Behavior of Materials; Equipment; and Heat Transfer.

The committee invites the cooperation and participation of all members of the ASCE in the furtherance of its objectives. It is particularly interested in assistance in gathering information currently available in the areas outlined.

The chairman of the committee is Capt. P. W. Roberts, Public Works Officer, New York Naval Shipyard, Brooklyn, N.Y. Secretary to the committee is Donald D. King, editor, *Construction Equipment*, New York, N.Y. George W. Rathjens, of the University of California, Amos J. Alter, of Juneau, Alaska, Harry L. Kinsel, of Boston, Mass., Kenneth A. Linell, of Needham, Mass., Charles W. Walker, of New York City and James D. Brannian, of Bellingham, Wash., as alternate, complete the roster.

Division Status for Pipeline Committee

The Construction Division's Pipeline Committee has grown up to Division status and now constitutes the Society's fourteenth Technical Division. During the Pittsburgh Convention the organization of this newly authorized Division will be completed and its officers named.

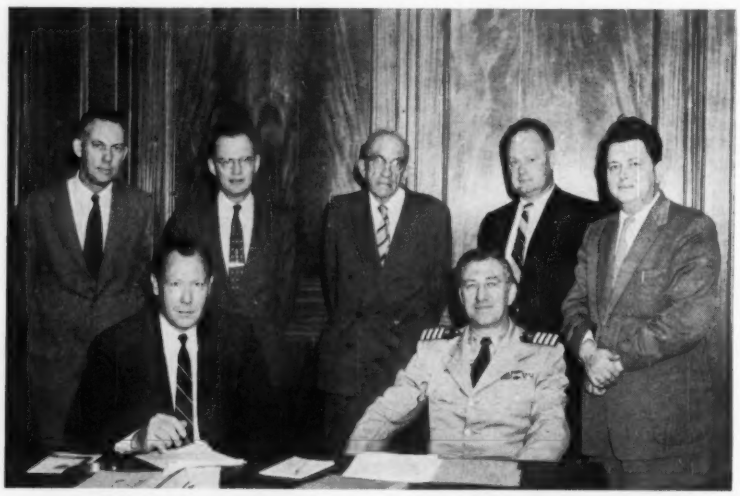
Convention Programs

Two excellent sessions were presented by the Division at the Knoxville Convention. The theme of both was "Industry in the South—Its Economic Impact, Past, Present and Future." The paper by G. W. Reynolds, plant engineer, Rome Kraft Co., Rome, Ga., published in the July issue of CIVIL ENGINEERING under the title, "Kraft Paper Plants—Their Basic Design, Construction and Operation," gave emphasis to the growing chemical and pulp-paper industry in the South.

An unusually interesting two-part program for the Pittsburgh Convention is scheduled by the Construction Division. The complete program is in the September issue, but attention is again drawn to it. The program begins on Monday morning, October 15, with a paper on the design of the containment structure for the atomic power reactor being built south of Detroit, by the Detroit Edison Co. and several other private companies. Universal interest in the building and launching of the earth satellite during the next year will heighten interest in a paper, which will feature the use of magnesium in the construction of the satellite. This AEC-sponsored project is known as "Vanguard." Charles W. Davis, chairman of the Division's Executive Committee, will preside. Chan Turner, president of the Turner Construction Co., will speak with the authority of an expert on the effect of new and radical designs for monumental-type office buildings on their cost, and the effect of more advanced methods of construction on the design of such buildings. If you need to know how our national labor situation affects today's construction costs, you will not want to miss the talk by William Dunn, assistant secretary of the AGC.

The Pipeline Committee (it will become a Division during the Convention) will interest all pipeliners with its Tuesday program on the design of pipelines, and their protection against corrosion and pulsating pressures. An inspection of the pipe-manufacturing facilities of the McKeesport Mill of the National Tube Division and a trip to inspect Pittsburgh's $22,000,000 County Home and Hospital, now under construction, will complete the contribution of the Division to the Convention.

The Construction Division registration has passed 6,000. The Division solicits the help of every construction man who has had valuable experience in preparing and submitting manuscripts for publication. Information on which this report is based was submitted by William Gartner, Jr., J.M. ASCE, news editor of the Division.



New Committee on Cold Weather Construction meets in New York for organization of activities. Seated are Donald D. King, secretary, and Capt. Palmer W. Roberts, chairman. Standing are Kenneth A. Linell, H. J. Kinsel, George W. Rathjens, James D. Brannian (attending as alternate for Charles W. Walker), and Amos J. Alter.

Junior Members—Watch Your Transfer Privilege

Are you one of the more than 1,200 Junior Members who must act before December 31 of this year to continue your membership in ASCE? Each such Junior Member was notified by Society Headquarters last spring, and to those who have not responded a final reminder is currently in the mail. Receipt before December 31, 1956, of your application for transfer to higher membership or a letter petitioning the Board for an extension of time will continue your membership until action has been taken on either your application or your petition.

Generally, there are three classifications of Junior Members whose membership will terminate on December 31, 1956, unless appropriate action is taken.

1. A Junior Member elected to membership in the Society after July 5, 1950, and attaining his 32nd birthday during 1956 must, under Article II, Section 4, of our Constitution, be dropped from the rolls of ASCE "...unless he shall have been transferred previously to a higher grade of membership, or by vote of the Board of Direction shall have been granted an extension of time in order to fulfill requirements for the grade of Associate Member."

If, because of circumstances beyond his control, such a Junior Member's engineering career has been interrupted, as by military service, he should petition the Board for an extension of time. This petition may be in letter form and should include an outline of the petitioner's experience, the reason for interruption of his career, and an estimate of the time required to qualify for Associate Membership.

2. Junior Members elected to membership prior to July 5, 1950, or whose application was received at Society headquarters before April 19, 1950, entered ASCE under a constitution that provided a 35-year age limit. Thus, any member in this group who passes his 35th birthday in 1956 must transfer or petition for an extension of time if warranted.

3. Those Junior Members who have already received an extension of time from the Board, which expires during 1956, must transfer or petition for more time in which to gain the experience necessary to qualify as an Associate Member.

Two questions frequently asked by affected Junior Members and the officers of their Local Sections are: Why are Junior Members dropped so suddenly by headquarters on reaching the age limit, and why does the application form for Associate Membership require such detailed information? Answers to both are quite simple.

First, the constitutional provisions regarding age limits are so clearly written that this is the only course of action open. It is mandatory that Junior Members who exceed these age limits be dropped if they do not file the required application for transfer or petition for extension of time.

The application form has only one primary function. It supplies the Application Classification Committee and the Membership Qualifications Committee with basic information for judging the applicant's fitness for the grade of membership sought. It is a vital part of ASCE's effort to maintain high standards of membership with grades that truly indicate a civil engineer's professional stature.

If you need further advice or help in preparing an application for transfer call on your Local Section officers to give it; or, if more convenient, address a letter to the Executive Secretary at Society Headquarters. Both you and the profession will benefit from your continued membership.

Tellers Canvass Ballot for 1957 Officers

New York 18, N.Y.
September 17, 1956

To the 1956 Annual Meeting
American Society of Civil Engineers:

The Tellers appointed to count the Election Ballots for Officers of the Society for 1957 report as follows:

For President
(Term October 1956–October 1957)

Mason G. Lockwood	10,823
Scattering	15
Void	20

For Vice-President—Zone II
(Term October 1956—October 1958)

Francis S. Friel	2,391
Scattering	3
Void	12

For Vice-President—Zone III
(Term October 1956–October 1958)

Norman R. Moore	2,904
Scattering	1
Void	15

For Director—District 1
(Term October 1956–October 1959)

Clinton D. Hanover, Jr.	1,090
Scattering	26
Void	1

For Director—District 4
(Term October 1956–October 1959)

E. Leland Durkee	560
Scattering	0
Void	2

For Director—District 8
(Term October 1956–October 1959)

Howard F. Peckworth	629
Scattering	0
Void	3

For Director—District 11
(Term October 1956–October 1959)

Finley B. Laverty	1,934
Scattering	3
Void	3

For Director—District 14
(Term October 1956–October 1959)

William J. Hedley	540
Scattering	0
Void	5

For Director—District 15
(Term October 1956–October 1959)

Randle B. Alexander	1,040
Scattering	2
Void	4

Ballots counted	22,026

Ballot envelopes rejected:

Without signature	149

Respectfully submitted,

Thomas J. Wickman, *Chairman*
Howard Grill, *Vice-Chairman*
George A. Burpee
Charles W. Buttz
Fred Caiola
Anthony S. Caserta
Egidio O. Di Genova
William R. Gibson
Edgar H. Hendler
Anthony N. Mavroudis
Walter E. O'Leary
Richard H. Tatlow, III
Irwin S. Toporoff

(*Tellers*)

ASCE MEMBERSHIP AS OF SEPTEMBER 10, 1956

Members	9,301
Associate Members	12,226
Junior Members	18,281
Affiliates	72
Honorary Members	46
Total	39,926
(Sept. 9, last year	39,167)

On the Pittsburgh Convention Tours

Annual Convention visitors to Pittsburgh will find the impressive headquarters buildings of the U.S. Steel Corporation and the Aluminum Company of America on the agenda of tours arranged for their edification. The buildings flank beautiful new Mellon Square Park, and are adjacent to the Convention hotel. This tour is scheduled for Tuesday, October 16, 7 to 9:30 p.m.

New Committees to Recommend Practice in Four Fields of Reinforced Concrete

At a meeting of the Structural Division's Committee on Masonry and Reinforced Concrete, held in Chicago on August 1, the group took steps to participate even more widely in the development of information in new fields of reinforced concrete. Four new committees were appointed to prepare reports on recommended practice in four rapidly developing fields of design and construction.

The first of these was a Committee on Limit Design, set up under the chairmanship of Alfred L. Parme, Portland Cement Association, Chicago, to develop a recommended practice applicable to reinforced concrete. This committee will study the readjustment of moments in frames and other indeterminate structures due to plastic action and will make design recommendations. Such a study is needed to supplement the recent ASCE-ACI Joint Committee Report on Ultimate Strength Design.

A second committee was set up to develop recommended practices with respect to precast structural concrete design and construction, a rapidly expanding field seriously in need of standards at the present time. Jack R. Janney, consulting engineer of Chicago, was named chairman.

A third committee—on composite construction, with Dr. Ivan M. Viest, research professor, University of Illinois, as chairman—will study the interaction of concrete decks on steel, timber, and precast concrete supporting members.

A fourth committee—on reinforced masonry design and construction—was charged with the task of developing recommended practice for reinforced masonry construction, including brick, tile, and concrete. This type of construction is extremely important in areas subject to earthquakes. Appropriately Albyn Mackintosh, consulting engineer of Los Angeles, was designated chairman.

The American Concrete Institute has approved co-sponsorship of the committees on limit design and composite construction.

Reports from existing committees were very encouraging. The Joint ASCE-ACI Committee on Reinforced Concrete Slabs, under the chairmanship of Dr. Nathan M. Newmark, head of the department of civil engineering, University of Illinois, has set up a test program on multiple-panel floor slabs under the sponsorship of the Reinforced Concrete Research Council of the Engineering Foundation. The four-year experimental program will cost approximately $140,000. Analytical work will begin this fall, and tests will be started as soon as models can be constructed.

The Committee on Folded Plate Construction (originally called Hipped Plate Construction), under L. C. Maugh, professor of civil engineering at the University of Michigan, reported that the tests on aluminum models have been completed as has a larger test on a concrete model at the University of Syracuse. The committee is now in the process of analyzing the test results, and a final report is expected in the fall of 1957.

The Committee on Prestressed Concrete, under Thor Germundsson, Portland Cement Association, is making excellent progress and expects to ballot on its final report about November 1, with publication to follow early in 1957.

The Joint ASCE-ACI Steering Committee on the "1940 Joint Committee Report," under Raymond C. Reese, consulting engineer, Toledo, Ohio, reported its recommendation that the old 1940 Joint Committee Report on Concrete and Reinforced Concrete be discontinued since the ACI Building Code is a more current document and, together with other codes of practice, satisfies all present needs. This action has been approved by the Executive Committee of the ASCE Structural Division and the Technical Activities Committee of the ACI. Other cooperating organizations are being notified of the action taken.

The Committee on Ultimate Strength Design, under Leo H. Corning, Portland Cement Association, has made its final report and awaits only the preparation of closing discussion before it asks for discharge. The report was published in its entirety as ASCE Proceedings Separate 809 and in part in the ACI Journal, Vol. 27, No. 5. It is the basis for an appendix to the ACE Building Code Requirements for Reinforced Concrete, 1956.

The Committee on Shear and Diagonal Tension, under the chairmanship of Charles S. Whitney, consulting engineer, New York and Milwaukee, hopes to be able to bring in a report shortly. Most of the necessary research has been completed, and the resulting data are being studied.

Robert F. Blanks' long and effective leadership of the Committee on Masonry and Reinforced Concrete was acknowledged with a rising vote of thanks. As of October 1 the chairmanship passes to Phil M. Ferguson, head of the department of civil engineering, University of Texas.

Ben Moreell, Hon. M. Wins John Fritz Medal

This year's winner of the John Fritz Medal, joint award of the four Founder Societies, is Admiral Ben Moreell, chairman of the board of the Jones & Laughlin Steel Corp., Pittsburgh. Presentation of the gold medal and certificate signifying the honor will be made on October 17 in Pittsburgh during the Annual Convention of ASCE, in which Admiral Moreell holds honorary membership. He is cited a "distinguished engineer and noted officer; builder of Naval works in war, and in peace; eminent industrialist and civic leader, devoted servant of church and country."

Entering the Navy in 1917, he was assigned to the Civil Engineer Corps as assistant to the Public Works Officer at the New York Navy Yard. He became chief of the Bureau of Yards and Docks and Chief of Civil Engineers of the Navy,

$890,000 WASHO Test confirms...

Standard ASPHALT pavements carry the heaviest legal axle loads

Q What was the WASHO Test?

A A dynamic test of Asphaltic concrete pavements made at Malad, Idaho. It entailed 119,003 test trips during a two-year period under all weather conditions.

Q What does "WASHO" mean?

A Western Association of State Highway Officials.

Q How was the test made?

A Loaded trailer-trucks were operated over 2 test loops. Each straight-away contained five 300-foot test sections. Over-all thicknesses were 6, 10, 14, 18, 22 inches. Pavement thicknesses were 2 and 4 inches. Foundation soil: A-4-8 silt of moderate plasticity.*

Q What was the least structure to carry the 18-kip† load without distress?

A 2-inch Asphaltic concrete pavement over 14-inch sub-base.

Q What was the least structure to carry the 40-kip load without distress?

A 4-inch Asphaltic concrete pavement over 14-inch sub-base.

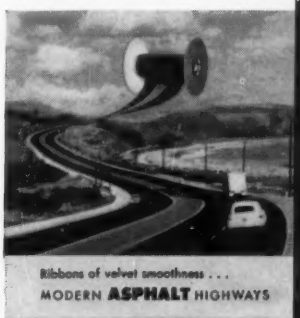
Q What did test reveal about Asphaltic concrete-paved shoulders?

A They permit reduction of over-all thickness by several inches. They lower maintenance costs. Increase safety through greater width.

Q Can these findings be applied generally?

A Yes . . . with normal engineering modifications for climate, foundation soil, aggregate, etc.

THE ASPHALT INSTITUTE
Asphalt Institute Building
College Park, Maryland



*Ref.: Highway Research Board Special Reports
18, "The WASHO Road Test – Part 1: Design, Construction and Testing Procedures"
22, "The WASHO Road Test – Part 2: Test Data, Analyses, and Findings"
†Kip–1000 lbs.

a position he held through World War II. Late in 1945 he was appointed chief of the Materials Division of the Office of the Assistant Secretary of the Navy to co-

Admiral Moreell

ordinate all materials procurement of the Navy. In February 1941, at the age of 51, he became the Navy's youngest vice-admiral, and in June 1946 he became the first officer, not a graduate of Annapolis, (his alma mater was Washington University, St. Louis) to hold the four-star rank of admiral. Organizer of the Seabees during the war, he had by the end of the war directed a $10 billion construction program in building up the shore establishment needed to back up the fleet. Following his retirement from the Navy in 1946 Admiral Moreell was elected president of the Turner Construction Co. In March 1947 he became chairman of the board and president of the Jones & Laughlin Steel Corp. He relinquished the office of president in 1952, but remains as chairman of the board and chief executive officer of the corporation. One of Admiral Moreell's many important peacetimes services has been his recent chairmanship of the Task Force on Water Resources and Power of the Second Hoover Commission.

The John Fritz Medal was established on August 21, 1902, the 80th birthday of John Fritz, at a dinner given in his honor by friends and professional associates who desired to perpetuate the memory of his achievements in industrial progress.

Hoover Medal for 1956 Goes to Herbert Hoover, Jr.

Herbert Hoover, Jr., Under Secretary of State, has been elected 1956 recipient of the Hoover Medal, joint award of the four Founder Societies. Named after former President Herbert Hoover, Hon. M. ASCE, father of the present recipient, the medal has been awarded annually since its establishment in 1930 "by engineers to a fellow engineer for distinguished public service." President Hoover was the first winner of the medal, which is considered one of the highest honors in the engineering profession.

The younger Mr. Hoover's career has been largely in the field of petroleum geophysics. He was graduated from Stanford University in 1925, with an A.B. degree, and in 1928 received the degree of master of business administration from Harvard. He had a teaching fellowship at California Institute of Technology, of which he later became a trustee. His interest in geophysics grew out of his airline engineering activities in the West. He became president of United Geophysical Corp., Pasadena, Calif., in 1935, and later was made chairman of the Board. He divested himself of all business interests several years ago when he undertook the assignments in foreign relations that led to his appointment as Under Secretary of State.

Like his distinguished father before him, Mr. Hoover is a member of the AIME, and will receive his award under the auspices of that organization at one of its early meetings.

Hydraulics Conference Features Valuable Technical Sessions

A number of valuable contributions to hydraulic engineering were made by the authors who presented papers at the Hydraulics Conference held at the University of Wisconsin, in Madison, August 22–24. This annual conference of ASCE's Hydraulics Division had as co-hosts this year the University of Wisconsin and the Wisconsin Section of the Society. Some 300 hydraulicians attended and enjoyed, in addition to the technical sessions, an inspection trip, a baseball game, and other recreational features.

To enjoy the latter with them, many brought their wives and children—a total of 60 wives and 44 children. This enthusiastic turnout was one of the indications of the success of the efforts made by the local committee, under the general chairmanship of Prof. Arno. T. Lenz, president of the Section, to get the younger members to come by making housing for them available in Adams Hall, a university residence hall on the shore of Lake Mendota.

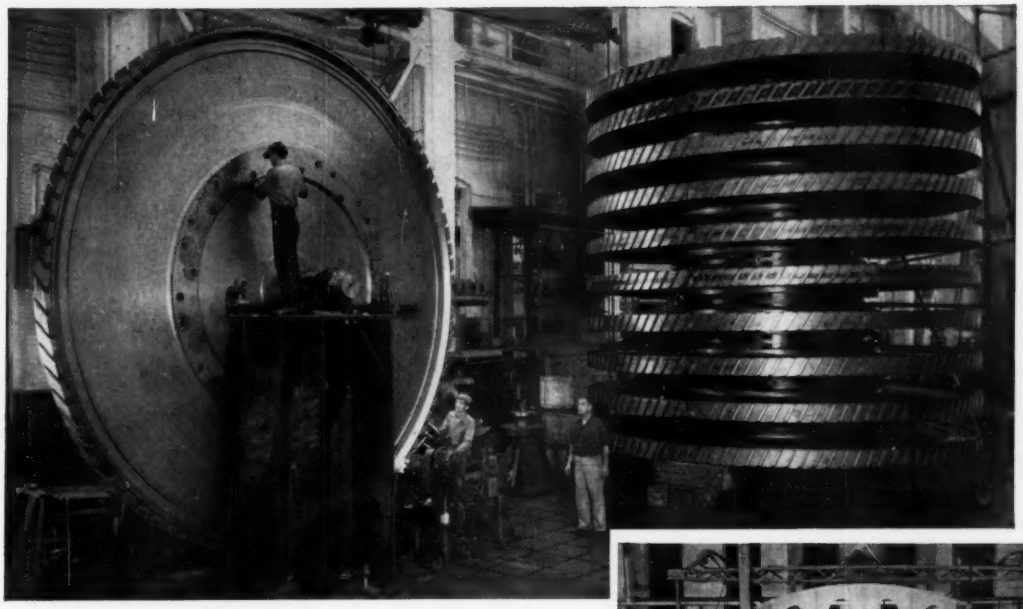
Five technical sessions were held—on floods, hydrology, sedimentation, research, and design—each under the sponsorship of the corresponding committee of the Hydraulics Division. Active throughout the sessions, both technical and recreational, were the members of the civil engineering department of the university, many of them long-time active members of ASCE.

At the opening session, on floods, four engineers from California, all directly connected with flood problems in the Golden State, told the dramatic story of the disastrous floods that ruined the 1955 Christmas season for thousands of Californians, cost at least 67 lives, and resulted in economic damage that mounted into hundreds of millions of dollars. If all the authorized flood control projects, as well as those proposed by the Corps of Engineers, had been in operation, about three-fourths of the economic damage, and more than half the loss of life, would have been presented, stated Frank Kochis, A.M. ASCE, chief of the Engineering Division, Corps of Engineers, Sacramento District, in his paper.

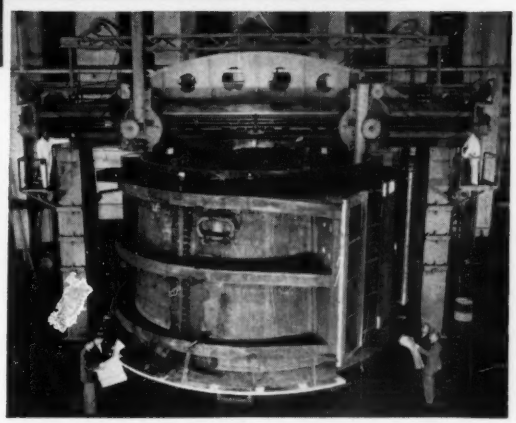
The other three authors who evaluated the extent and effects of this California flood were Walter G. Schulz, M. ASCE, and Jack F. Hannaford, J.M. ASCE, both of the California state engineering staff; and Joseph I. Burns, J.M. ASCE, senior hydraulic engineer of the California Division of Water Resources, all of Sacramento.

The afternoon session, devoted to the general theme of winter hydrology, heard first the experience of two professors of civil engineering, who had studied 14 years of snow-melt records and from them prepared a procedure for determining spring snow-melt runoff for any river system. These two authors were Prof. J. Harold Zoller, from the University of Wyoming, and Prof. Arno T. Lenz, from the University of Wisconsin. The records they studied were those of the Big Eau Pleine River basin in Wisconsin.

Two papers were devoted to the measurement of stream flow under ice conditions, by A. M. Moore, A.M. ASCE, assistant district engineer, U.S. Geological Survey, Portland, Ore., and by H. M. Erskine, M. ASCE, district engineer, U.S.G.S., Bismarck, N. Dak. The last paper in this session by W. G. Fielder, M. ASCE, area operating superintendent for the Niagara Mohawk Power Corp., Potsdam, N. Y., presented winter prob-



Rotor discs for mammoth 11-stage compressor were balanced and stacked for alignment in one of Newport News' five huge machine shops. Large engineering and technical staffs with a vast plant make Newport News an ideal source for large equipment . . . *standard or special in design.*



A 35-foot boring mill in Newport News' plant machining the 374,000-pound upstream housing for the giant axial flow compressor. The compressor is heart of an 8-foot supersonic wind tunnel at the Ames Aeronautical Laboratory of the National Advisory Committee for Aeronautics at Moffett Field, Calif.

To create winds exceeding

2000 MPH

Newport News builds world's Mightiest Compressor

Whenever you want large units built with careful attention to detail, give the job to Newport News.

This company recently built an eleven-stage axial flow compressor that shatters all previous records for wind force . . . using what is believed to be the world's largest rotating object.

The rotor, weighing more than 400 tons, comprises eleven huge discs. Each disc, machined from a 96,000-pound forging, was finished to a 50,000-pound wheel and balanced to within 26 ounces at the rim. In each rim, slots for blades were machined to within .005″ on special milling heads designed and produced in the Newport News plant.

Here at Newport News, you'll find more than large productive capacity. In machine shops, foundries and forging plants Newport News craftsmen complete your orders with specialized techniques backed by experience in fabricating thousands of products.

Newport News' craftsmen produce units that range from small components of spinning machines, to mammoth hydraulic turbines . . . from piping, pumps and valves, to vacuum tanks, digesters and bridge caissons.

These skilled men handle the job exactly as you want it done, for maximum results per dollar invested. So let us bid on your present or future projects. Learn how Newport News can help you. Send for our illustrated booklet entitled, "Facilities and products" . . . it's your for the asking.

Newport News

Shipbuilding and Dry Dock Company

Newport News, Virginia

lems at 42 hydroelectric plants, ranging in size from 360 to 29,500 kw.

The role of sedimentation—silt, sand, and gravel transported by flood waters—in the watershed and soil conservation program of the nation, was the subject of the Thursday morning session. Two members of the U.S. Soil Conservation Service, F. H. Larson, M. ASCE, and Robert Hall, both of Upper Darby, Pa., told of the extensive damage to farm lands, reservoirs, and other facilities by sedimentation. Next the successful use of steel jetties for bank protection and channelization of rivers was explained by E. J. Carlson, M. ASCE, and P. F. Enger, J. M. ASCE, two hydraulic engineers with the U. S. Bureau of Reclamation in Denver

How sand dunes are formed in alluvial channels and their effect on the smooth flow of water, was discussed in the paper presented jointly by Maurice L. Albertson, M. ASCE, professor of civil engineering at Colorado A. and M. College, and his former colleague there, Said M. Ali, now with the Harza Engineering Co. of Chicago.

At the session on research, Thursday afternoon, the use of electronic computers to solve various hydraulic problems was discussed. A new electronic machine, built in the electrical engineering department of the University of Wisconsin, was described by its builders—Morton Spooner of Madison, Wis.; Prof. Vincent C. Rideout, of the University of Wisconsin; and William C. Schultz, Sheboygan, Wis.

Another machine, an electric analog model, in which voltages and electric currents take the place of water elevations and flows in analyzing the motion of flood and tidal waves, was described by James A. Harder, assistant research engineer of the University of California Institute of Engineering Research.

The Army Corps of Engineers has been conducting an extensive investigation to adapt water management and power generation problems of the large multi-purpose reservoir system on the Missouri River to solution by automatic high-speed electronic computers. This unique new use of computers was explained by R. J. Pafford, Jr., head hydraulic engineer and chief of the reservoir control center, Missouri River Division, U. S. Corps of Engineers, Omaha, Nebr.

A new and quicker method for figuring water-surface profiles was outlined by Francis F. Escoffier, hydraulic engineer with the Corps of Engineers, Mobile, Ala.

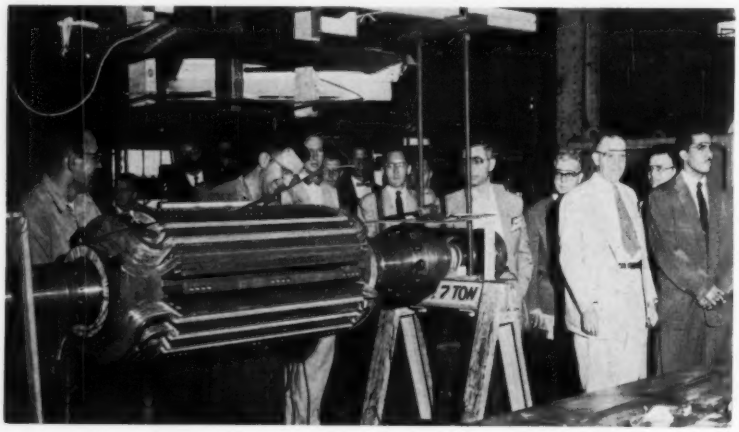
In the last session, on design, the value of mixed-gravel armor plate to prevent erosion and scour in drop structures was discussed by M. L. Albertson, M. ASCE, professor of civil engineering at Colorado A. and M. College.

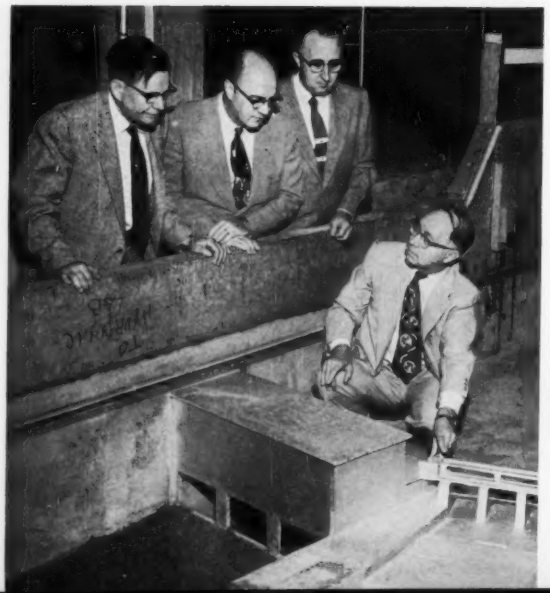
A study of pipe friction loss at high pressures has shown that "the standard pipe-friction theory is valid for high pressures and temperatures, provided the appropriate effects of pressure and temperature on the properties of the fluid are known." This study was reported by J. G. Slater, chief engineer of W. C. Heath Associates, Inc., Milwaukee; J. R. Villemonte, A.M. ASCE, associate professor of civil engineering at the University of Wisconsin; and H. J. Day, senior project engineer of the Scott Paper Co., Glenn Falls, N. Y.

While the men were engaged with technical matters, the wives and children enjoyed an outstanding program of their own. All tours started from headquarters in La Follette House, Adams Hall, under the direction of Mrs. J. G. Woodburn, chairman of the Ladies Committee.

Featured speaker at the annual Hydraulics Division banquet was President Enoch R. Needles, who gave an interesting account of early water supply engineering in the New York area, stressing the work of men who were among the founders of the Society. Mr. Needles also gave a comprehensive report on present-day Society activities. Division Chairman Joseph Tiffany was toastmaster at the banquet. Guests of honor included ASCE Past-President J. C. Stevens, of Portland, Ore., one of the founders of the Division, and Albert S. Fry, of Knoxville, Tenn. A citation presented Mr. Fry by the Hydraulics Division in appreciation of his work for the Division was read.

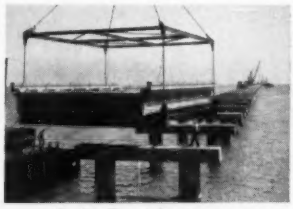
The local committees did an outstanding job in making the conference a success. Registration was under the chairmanship of Prof. J. R. Villemonte; housing under Prof. G. A. Rohlich.





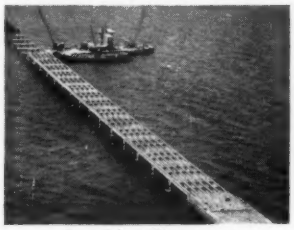
Coils being put in position in slotted rotor engage attention of Hydraulics Division members enjoying inspection trip to West Allis Works of Allis-Chalmers Manufacturing Company. Trip was attended by about 170.

A fine point in dam construction, illustrated by model in Hydraulics and Sanitary Engineering Laboratory at University of Wisconsin, is explained by Prof. Arno T. Lenz, president of Wisconsin Section (kneeling) to (from left) Louis E. Rydell, Director of ASCE; Joseph B. Tiffany, chairman of executive committee of Hydraulics Division and assistant director of Waterways Experiment Station at Vicksburg; and Harold M. Martin, chief, Hydraulics Laboratory of U. S. Bureau of Reclamation, Denver.



Lake Pontchartrain

Havana Stadium



Sunshine Skyway

Kitimat Dock

Concrete Ships

What Feature* Is Common to Each of these Outstanding Concrete Structures?

PRESTRESSED CONCRETE PROJECTS:

1956 – **Lake Pontchartrain Bridge** – 24 miles of precast, prestressed deck spans – Palmer and Baker, Consulting Engineers

1956 – **Hangar at Hill Air Force Base** – 84 ton precast, prestressed girders spanning 130 feet – Roberts & Schaefer, Consulting Engineers

1956 – **Havana Sports Stadium** – 286' thin shell dome with prestressed ring girder – Professor J. Vila and The Preload Company, Inc., Consulting Engineers

1955 – **Hampton Roads Project** – 2 miles of prestressed beam spans and prestressed piles – Parsons, Brinkerhoff, Hall & McDonald, Consulting Engineers

1954 – **Sunshine Skyway across Tampa Bay** – 3½ miles of prestressed beam spans – Parsons, Brinkerhoff, Hall & McDonald, Consulting Engineers

1953 – **Bridge at Heilbrun, Germany** – 353 foot span, world's longest prestressed span – Dr. Moersch, Consultant

1952 – **Office Building, Glenn L. Martin Co.** – 3 story precast, prestressed members bolted into place–Engineering Dept. of Glenn L. Martin Co., and The Preload Company, Inc.

1949 – **Walnut Lane Bridge, Philadelphia** – First large prestressed bridge in U.S. with a span of 155 feet – Engineering Dept. City of Philadelphia, The Preload Company, Inc. and Professor G. Magnel, Consultants

FLOATING CONCRETE STRUCTURES

1955 – **Tappan Zee Bridge, New York Thruway** – 6 buoyant boxes to support 80% of the weight of the main piers – Madigan-Hyland, Captain Emil H. Praeger, Consulting Engineers

1954 – **Kitimat Dock, British Columbia** – Cast on side and rotated 90° by shifting ballast – Frederick R. Harris, Consulting Engineers

1952 – **Pier 57, New York City** – 3 buoyant boxes with a total displacement of 73,000 tons floated 38 miles to permanent position at 15th Street, in New York City. Madigan-Hyland, Captain Emil H. Praeger, Consulting Engineers

1946 – **Floating Drydock, Uruguay** – longest in the world

1943-44 – **Floating Drydock Program, U.S. Navy** – 13 large docks with a capacity of 2800 tons, and 2 smaller docks with a capacity of 400 tons

1942-45 – **Concrete Ship Program** – 125 ships and barges built for U.S. Maritime Commission during World War II

*The feature common to each of these projects is the use of Plastiment Concrete Densifier to obtain uniformity, uniform high strength and resistance to water and cracking.

Of course, the great volume of Plastiment is consumed in every day concrete work such as conventional reinforced buildings, water reservoirs, and similar structures.

For a detailed explanation of Plastiment action in concrete, write today for the 8 page bulletin "Plastiment Concrete Densifier."

Sika®

PLASTIMENT® CONCRETE Ddensifier

SIKA Chemical Corporation, Passaic, New Jersey

DISTRICT OFFICES: BOSTON • CHICAGO • DALLAS • PHILADELPHIA • PITTSBURGH • SALT LAKE CITY • WASHINGTON, D.C.
MONTREAL, CANADA • VANCOUVER, CANADA • PANAMA CITY, PANAMA • DEALERS IN PRINCIPAL CITIES

New Award Honors ASCE Past-President Howard

This year ASCE is making its first presentation of the Ernest E. Howard Award, established in honor of the late Past-President. Mr. Howard, shown here with Mrs. Howard, was a partner in the New York and Kansas City firm of Howard, Needles, Tammen and Bergendoff. The award is for meritorious service in the field of structural engineering and construction. The first medalist is Prof. Ralph E. Boeck, of Marquette University (page 77).

Scheduled ASCE Conventions

ANNUAL CONVENTION
Pittsburgh, Pa.
Penn-Sheraton Hotel
October 15–19, 1956

JACKSON CONVENTION
Jackson, Miss.
Hotel Heidelberg
February 18–22, 1957

BUFFALO CONVENTION
Buffalo, N. Y.
Hotel Statler
June 3–7, 1957

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

Society members happening in the Mobile, Ala., area early in December are cordially invited to attend the **Alabama Section's** winter meeting, to be held at the Battle House Hotel, December 7 and 8. One of the highlights of the two-day get-together,—a joint session with the Section's two Student Chapters—will be a trip to Dauphin Island, called "the playground of the Gulf Coast." This area, which is currently being developed, offers interesting and varied types of construction. Fort Gaines, a historic bastion on the coast, will also be visited.

The **Georgia Section** resumed its monthly meetings on September 7, when Admiral Kirby Smith (now retired from the Navy and on the staff of Robert and Company Associates in Atlanta) gave an illustrated talk on the fabrication and installation of the Texas Tower off Georges Bank. The outstanding slides included views of the radar station weathering its first hurricane. Junior Member Henry Klosterman will assist Gordon Dalrymple in editing and publishing the Section's newsletter, "Civil Engineering in Georgia."

The **Illinois Section,** along with the other engineering societies in the Chicago area, is sponsoring a "program for advancement" that has for its aim better-rounded engineers. The program, which gets under way late in September, consists of eight separate series of weekly lectures running through the fall and early winter. Typical offerings, in addition to three professional engineer refresher courses, are Business Management for Engineers, Conference Leadership, and Law for Engineers. Major industrial corporations in the Chicago area and local universities are supplying the lecturers.

Of major importance for sanitary engineers is the two-day conference the **Kansas City Section** is sponsoring on November 19 and 20. The diverse program will include talks by R. E. Fuhrman, executive secretary and editor of the Federation of Sewage and Industrial Wastes Associations, on "General Aspects of Sanitary Engineering"; E. J. Kallin, of the Ford Motor Co., on "Industrial Waste Treatment"; Arthur Stern, of the U. S. Public Health Service, on "Air Pollution"; W. H. Wisely, executive secretary of ASCE, on "Certification of Sanitary Engineers"; W. Q. Kehr, director of the St. Louis Sewer District, on "Metropolitan Sanitary Engineering Problems"; W. E. Johnson, chief of the Engineering Division, Missouri River Division, Corps of Engineers, on "Effects of Missouri Basin Development on River Flow"; and Glen J. Hopkins, regional engineer for the U. S. Public Health Service at Kansas City. H. Roe Bartle, mayor of Kansas City, will address the Monday luncheon meeting, and Arthur D. Caster, secretary of the ASCE Sanitary Engineering Division, the Tuesday luncheon.

In its September newsletter the **Kansas Section** urges its members to take a hand in meeting programs by ferreting out new speakers and new talent. Each member, it points out, is constantly making contacts with potential speakers—in his work, his recreation, his church, to mention a few. "Look around you. Get an idea for a good program, and suggest it to the program committee," the Section urges.

Highways were the topic engrossing 35 members of the **Maine Section's Vermont Branch** on August 25. Several road construction projects in the St. Albans and South Burlington areas were visited. The group then lunched at Lincoln Inn in Essex Junction, Vt., and heard the projects discussed by E. H. Stickney, district engineer for the Vermont Highway Department, and other department representatives.

A special type of luncheon meeting, initiated on a trial basis by the **Metropolitan Section** in June, was repeated by popular demand at the end of the summer. Getting away from engineering, the programs featured talks by Meyer Berger, of the *New York Times*, and Dwight Michner, economist with the Chase-Manhattan Bank.

The **Nashville Section** is planning a Highway Committee to give all possible help and advice to state highway officials in carrying out the new highway program. The Tennessee Valley and Mid-South Sections have been invited to have members on the committee.

A talk on "Traffic Needs of the Urban Areas of the Future" got the **National Capital Section's** fall program off to a good start. Robinson Newcomb, a consulting economist, specializing in the construction and transportation fields, was featured speaker. Dr. Newcomb developed his subject by estimates of the growth of the country and its transportation requirements by 1975. In that year, he forecast, the population will probably be over 200,000,000, of which 90 percent

Members of Tacoma Section turned out en masse late in August for pre-opening inspection, by automobile, of scenic Stevens Canyon Highway into famed Mt. Rainier National Park. Here the group, almost a hundred strong, meets at Paradise Inn, park terminus of the new highway, for a picnic supper. Arthur R. Anderson was field trip chairman.

Recently elected officers of Mexico Section (announced in the September issue) pose with guests from the United States—Prof. Adelbert Diefendorf, head of department of civil engineering at University of Utah, and Raymond F. Dawson, ASCE Director for District 15 and professor of civil engineering at University of Texas. Shown (left to right, front row) are Leopoldo Farias, vice-president; Professor Diefendorf, who has been conducting summer course in highway engineering at University of Mexico; Director Dawson; and Lorenzo Perex Castro, president. Behind them are Earle S. Sloan, past-president, and Miguel Montes de Oca, secretary-treasurer.

will be urban. The increase in population in the urban areas is expected to increase the demand for facilities, such as utilities. apartment houses, office buildings, and shopping centers. Dr. Newcomb concluded that "It all adds up to a tremendous demand on the services of the "civil engineer."

The lead editorial in a recent issue of *The Seattle Times* praises the **Seattle Section** for interesting itself in the City Planning Commission's new zoning code, and notes that the long-range importance of the code to the whole community "would justify equally careful and intelligent studies by many other groups that have not as yet attempted to analyze or understand the provisions of the new ordinance." The views of the Section, which has strongly endorsed the code, are described as highly "valued," because "civil engineers are more familiar with developments and principles of good municipal planning than the average layman."

Society Director Graham Willoughby was featured speaker at the **South Carolina Section's** annual summer meeting held in Charleston on August 17 and 18. The meeting—a joint session with the South Carolina Society of Engineers—consisted of a business meeting, banquet, scenic cruise in Charleston Harbor, and a seafood luncheon.

Members of the **Syracuse Section's** new **St. Lawrence Branch** are congratulating Einar Skinnarland and his committee on the success of a recent Branch outing at Dry Island. Competition for prizes was keen, and a picnic climaxed the afternoon's activities.

New recruits to the staff of the *Tennessee Valley Engineer*, monthly publication of the **Tennessee Valley Section,** are Paul Hicks, who will succeed Assistant Editor Donald W. Newton as secretary to the board of editors, and Ernest M. Titus, who has joined the staff as a feature writer.

Coming Events

Alabama—Joint meeting with the Student Chapters at the University of Alabama and Alabama Polytechnic Institute at the Battle House Hotel, Mobile, December 7 and 8. Col. Harold E. Bisbort, Mobile, Ala., is in charge of arrangements.

Illinois—Fortieth Anniversary Celebration Banquet in the new George Bernard Shaw Room of the Sherman Hotel, Chicago. Social and cocktail hour at 5:30 p.m.; dinner at 7:00 p.m. Details from Raymond S. Knapp, chairman of the Anniversary Dinner Committee.

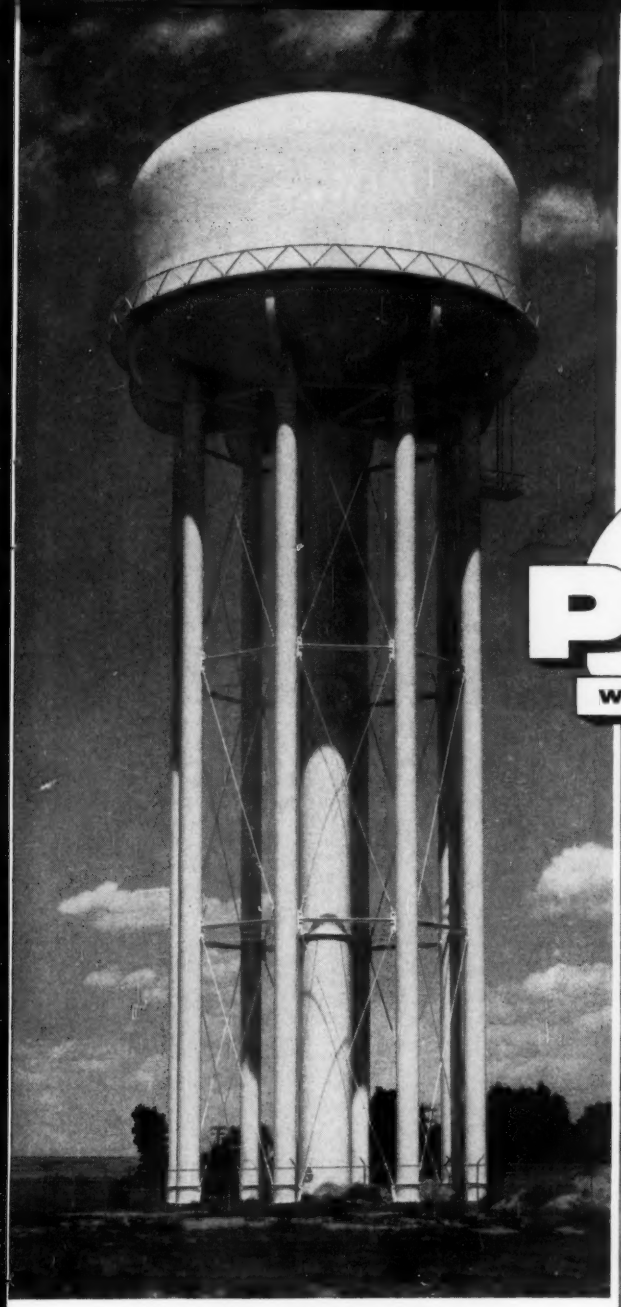
Kansas City—Sanitary Engineering Conference at the Continental Hotel, Kansas City, Mo., November 19 and 20. Information may be obtained from Glenn C. Gray, Chairman, Subcommittee on Publicity, Larkin and Associates, Consulting Engineers, 19 East Gregory Blvd., Kansas City 14, Mo.

Metropolitan—Regular meeting in the Engineering Societies Building, October 10, at 7:00 p.m. Meetings of the Junior Branch, Room 501 B, Engineering Societies Building, October 17 and November 7, at 7 p.m. Speaker at the latter session will be Dr. Lev Zetlin, consulting engineer.

Mid-South—Annual fall meeting at the Hotel Vicksburg, Vicksburg, Miss., November 1–3. Early Bird Party aboard Steamer Sprague, November 1, at 7:00 p.m.; technical and business sessions on November 2; and trip to Waterways Experiment Station, November 3, at 9 a.m.

Spokane—Luncheon meeting at the Davenport Hotel, Spokane, October 12, with consultants Carl R. Dion and H. E. Bovay discussing the hydroelectric potential of the Pacific Northwest.

Tennessee Valley—Annual meeting at the Hotel Patten, Chattanooga, November 2 and 3, with the Chattanooga Branch as host. Mark K. Wilson, 1478 Market St., Chattanooga, is program chairman.



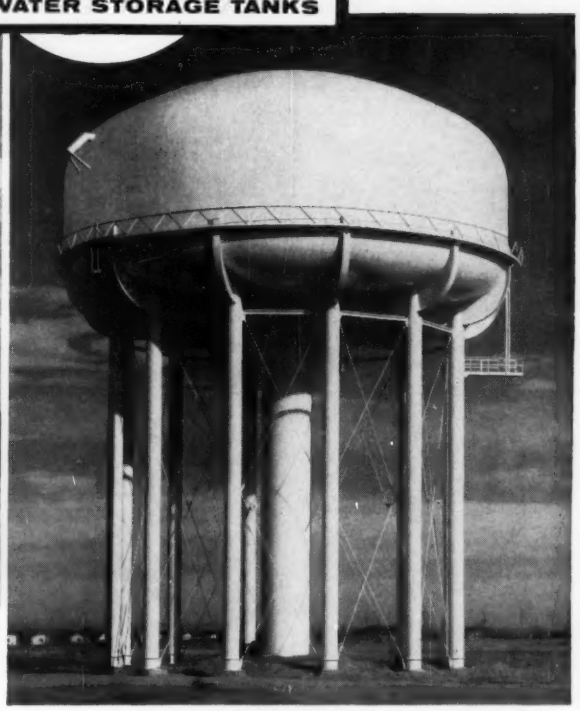
750,000 gallons capacity. Tank diameter 62 ft. Head range 35 ft. Height to bottom 120 ft.

The long and the short of

BETTER WATER SERVICE IN *Pueblo, Colo.*

PDM

WATER STORAGE TANKS



1,500,000 gallons capacity. Tank diameter 88 ft. Head range 35 ft. Height to bottom 70 ft.

Balancing the water service requirements of the City of Pueblo, Colorado, these strategically-located Pittsburgh-Des Moines Radial Cone Elevated Steel Tanks provide, with a 50-ft differential in tower heights, uniform water pressures over a large service area. Dependable supply is coupled with low head-range in this large-capacity tank type. Ask for our latest Catalog covering the complete range of PDM Elevated Steel Tanks.

PDM
WATER STORAGE TANKS

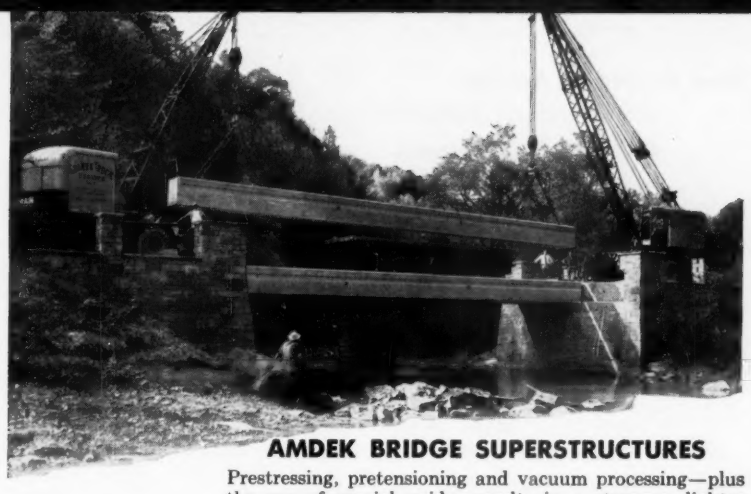
PITTSBURGH • DES MOINES STEEL CO.

Plants at PITTSBURGH, DES MOINES, SANTA CLARA, FRESNO, and CADIZ, SPAIN

Sales Offices at:

PITTSBURGH (25) . . . . 3470 Neville Island
NEWARK (2) . . . 251 Industrial Office Bldg.
CHICAGO (3), 1274 First National Bank Bldg.
EL MONTE, CAL. . . . . P.O. Box 2068
DES MOINES (8) . . . . 971 Tuttle Street
DALLAS (1) . . . . 1275 Praetorian Bldg.
SEATTLE . . . . . 578 Lane Street
SANTA CLARA, CAL., 677 Alviso Road
MADRID, SPAIN . . . Diego DeLeon, 60

MARIETTA PLANTS READY TO SUPPLY BILLION DOLLAR HIGHWAY PROGRAM



A giant in the construction materials industry, American-Marietta offers a related group of essential concrete products for use in building and rebuilding the nation's highways. American-Marietta has expanded its plants to supply the increased demand and to prepare for still more volume. Manufacturing facilities are strategically located throughout the United States to assure distribution near points of use. Send for complete information about any of the products illustrated on these pages.

AMDEK BRIDGE SUPERSTRUCTURES

Prestressing, pretensioning and vacuum processing—plus the use of special voids—results in a stronger, lighter bridge member that can be handled like steel beams in any weather. Pre-cast Amdek sections, above, were positioned in just six hours. Amdek eliminates painting and maintenance.

LO-HED PIPE

Elliptical Lo-Hed Pipe carries a greater flow than its round equivalent—in a minimum depth of cut with increased depth of cover. Easier to lay, to grade and line. Pre-tested strengths to answer any low headroom problem.

INNER CIRCLES

Tunneliner Process allows passing of pipe through pipe underground without requiring excavations or disruption of surface traffic. Work progresses regardless of weather conditions.

Our technical staff will be pleased to assist you with your problems.

AMERICAN-MARIETTA COMPANY
CONCRETE PRODUCTS DIVISION

GENERAL OFFICES: AMERICAN-MARIETTA BUILDING, 101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS • PHONE WHITEHALL 4-5600

DIVISIONS AND SUBSIDIARIES

Atlantic Concrete Pipe Co.
Concrete Conduit Company
Tellyer Concrete Pipe Co.
Concrete Products Co. of America
Lamar Pipe and Tile Company
Lewistown Pipe Company
Universal Concrete Pipe Co.
American-Marietta Company of Pennsylvania

NEWS BRIEFS . . .

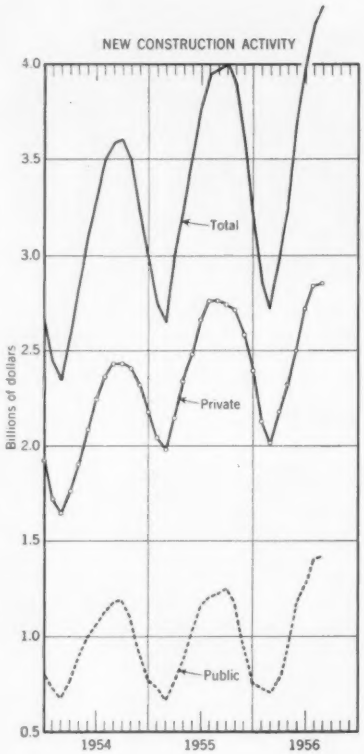
Construction Outlays Set New Record in August

The value of new construction put in place in August represented a seasonal rise to a new monthly high of nearly $4.3 billion, bringing outlays for the first eight months of the year to a record total of $28.4 billion, according to preliminary estimates of the U. S. Departments of Commerce and Labor. After allowance for seasonal changes, new construction activity in August was at an annual rate of $44.3 billion, compared with the $43 billion put in place during 1955.

Most major types of construction showed normal seasonal movement between July and August of this year. However, activity on military facilities, which usually shows a substantial gain in August, remained steady. Outlays for the month were at an all-time monthly high in the following construction categories: Office and warehouse buildings, private industrial plants, public utilities, schools, highways, sewer and water works, and public-service enterprises (mostly St. Lawrence Seaway facilities).

During the first eight months of 1956 private expenditures for new construction totaled $19.9 billion, equalling the January-August record of 1955. The decline over the year in private residential building ($977 million) was offset by advances in private industrial building ($443 million), utilities ($306 million), and commercial building ($298 million).

Public construction outlays for the January-August period this year, at $8.5 billion, were 6 percent above the total for the corresponding months of 1955. Increased spending for highways, public-service enterprises, and water and sewer lines more than compensated for a 51 percent drop in public industrial construction (mainly installations for the Atomic Energy Commission).



August construction activity, at new monthly high of nearly $4.3 billion, brings outlays for first eight months of year to record total of $28.4 billion.

New Electric Power Plant To Be Built in Indiana

A new $58,000,000 electric power plant, which will house the world's largest generating unit, is to be built by the Indiana & Michigan Electric Co. on the Wabash River south of Terre Haute, Ind. With a generating capacity of 450,000 kw, the generating unit will be 73 percent larger than any facility operating today. It is the first of two planned on the seven-state American Gas and Electric Company System, of which the Indiana and Michigan is a major part.

Philip Sporn, M. ASCE, president of the American Gas and Electric Company, describes the proposed plant as "a new plateau in power generation technology." To give an idea of the size of the first unit, it will be capable of supplying all the residential electric requirements of a city of 4,000,000. The plant is expected to show an improvement of 5 percent in thermal efficiency over any constructed to date. It will also show an improvement of $7\frac{1}{2}$ percent in capital cost per kilowatt of generating capacity, brought about by economies due to the larger size of the unit, higher turbine speed, space reduction, elimination of the boiler house, and many other factors.

Construction of the plant will be started soon, with completion scheduled for late in 1958. The new unit and its sister plant, which will be built on a site in another system, represent the final 900,000 kw of new power-production facilities in the AGE's recently announced $700 million five-year expansion program.

Italy Makes Plans for Milan-Naples Highway

A group of Italian engineers has been on an observation tour of United States toll road and other express highway facilities in preparation for the construction of a 440-mile highway between Milan and Naples. The road, which is called the Sunshine Highway, will be built by a company affiliated with the State Holding Corporation for Industry at an estimated cost of $300,000,000. About 40 percent of the cost will be provided by the state, and the remainder by bond subscription.

New Jersey Turnpike Extension Finished

Dedication of the Bayonne-Jersey City section of the $120 million Newark Bay-Hudson County extension of the New Jersey Turnpike took place on September 15 at the Holland Tunnel toll plaza in Jersey City. The speakers, headed by Robert B. Meyner, governor of New Jersey, pointed out the importance of the extension which virtually places Bayonne and Jersey City on the turnpike and provides a direct route from New York City to Newark Airport.

The new 8.2-mile connection between Jersey City and the Newark Airport interchange of the turnpike is a modern six-lane highway, with three wide lanes in each direction separated by a barrier-type median to avoid collision with opposing traffic and prevent glare from headlights. It will be lighted for its entire distance. A speed limit of 50 mph has been established for the extension except in bad weather when lower speeds will be posted. Tolls, which include passage over the long Newark Bay Bridge, range from 35 cents for passenger cars to 70 cents for buses.

Surveys indicate that the connection will carry about 15,600,000 vehicles in the first full year of operation, with toll revenues approximately $5,020,000.

Manpower Shortage Discussed at ASME Meeting

The United States is following a confused goal when it attempts to compete with the Russians in the field of scientific and engineering education. This is what Joseph W. Barker, M. ASCE, president of the American Society of Mechanical Engineers, told a luncheon gathering at the group's fall meeting held in Denver, Colo., early in September.

Referring to figures which indicate that the Soviet Union is outstripping the United States in the training of scientists and engineers, Dr. Barker said these figures were valid and significant. "I would be the last person in the world to ridicule them," he said, "but I think it is more important for us to look at our engineer shortage in terms of our own requirements, and not in terms of a frantic contest to make our statistics look better than those of the Communists."

Examined on that basis, Dr. Barker said, the engineer shortage is extremely serious and may get a lot worse before it gets any better. He cited figures just released by the Special Surveys Commission of Engineers Joint Council with the staff assistance of the Engineering Manpower Commission. The figures, based on questionnaires received from 414 industrial and government organizations employing about 140,000 engineering graduates, showed that they expect to increase the number of their engineer employees by 10.4 percent before the end of 1956, and that their actual estimated requirements would call for an increase of 14.2 percent if the men were available.

According to Dr. Barker, the problem tends to intensify itself because schools are unable to compete with industry to get the teachers to train more engineers, and because modern technology is increasing the demand by requiring a greater proportion of engineers to other workers in the labor force. He concluded that, "Our technology is threatening to strangle itself in its own complexity, simply because engineers and scientists are themselves creating the need for more engineers and scientists in geometrical progression."

NCSBEE Holds Annual Meeting in Los Angeles

The 35th annual meeting of the National Council of State Boards of Engineering Examiners took place in Los Angeles, August 23–25, with an attendance of 113 delegates from 45 states, the District of Columbia, and Hawaii. Among the guests were the representatives of twelve engineering societies, including William H. Wisely, Executive Secretary of ASCE; E. S. Strandh, technical adviser to the Swedish Embassy; and J. M. Muir, secretary of the Dominion Council of Professional Engineers.

A panel discussion of "Professional Engineering Registration," moderated by C. S. Crouse of Kentucky, proved of considerable interest. Actions taken included approval of the Canal Zone Board of Registration for Architects and Professional Engineers as a new member board of the National Council.

The outstanding feature of the annual banquet, which was attended by 200, was the presentation of the National Council's Distinguished Service Certificate for loyal and intelligent service to the Council and to the engineering profession. Recipients were C. L. Eckel, Director of ASCE and dean of engineering at the University of Colorado; Allen S. Janssen, A.M. ASCE, dean of the College of Engineering at the University of Idaho; William M. Spann, M. ASCE, consulting engineer of Kansas City; and Russell G. Warner, C. S. Crouse, Stanley G. Palmer, J. D. Guillemette, and Junius T. Moore.

New NCSBEE officers, installed during the banquet are, Edward R. Stapley, M. ASCE, dean of engineering at Oklahoma A & M College, president; Allen S. Janssen, president-elect; and Leo M. Odom, M. ASCE, and E. R. Dodge, A.M. ASCE, directors. T. Keith Legaré is executive secretary, with headquarters in the Palmetto State Bldg., Columbia, S.C.

Next year's annual meeting will be held at the Atlanta Biltmore Hotel, Atlanta, October 31–November 2.

Army to Have More Funds For Delaware River Work

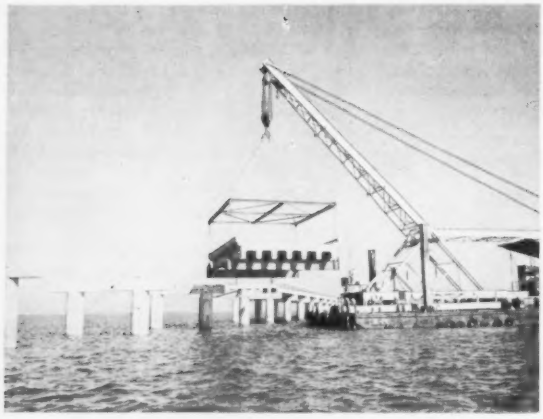
The Army Corps of Engineers will spend nearly $11,000,000 on Delaware River maintenance and improvement in the new fiscal year, according to Col. Allen F. Clark, Jr., district engineer. This is an increase of $4,500,000 over last year's expenditures. About $5,000,000 of the new appropriation will be spent on dredging the river between Philadelphia and Trenton, and $4,500,000 will go for maintenance dredging of the 40-ft channel between Philadelphia and the river mouth.

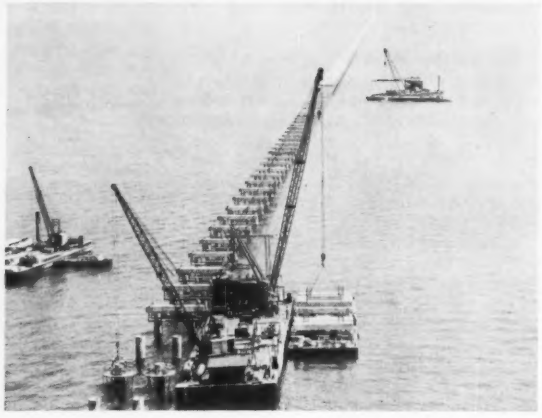
Over $3,500,000 will be spent for flood control in the district in comparison with $625,000 appropriated last year. The new appropriations provide for continuation of construction on Bear Creek Dam and Reservoir, start of construction on Dyberry and Pompton dams, and advance planning of protective works at Allentown and Bethlehem. Total estimated cost of these authorized flood control projects is close to $43,000,000.

Richmond–San Rafael Bridge Is Opened

Here in aerial view is the new $62,000,000 Richmond–San Rafael Bridge, which was dedicated on August 31 and opened to traffic a day later. Crossing the northern arm of San Francisco Bay, the three-lane 36-ft-wide structure replaces a ferry that has been increasingly inadequate to cope with traffic between the two cities. The project will provide six traffic lanes when current contracts for a second and lower deck of the same width are completed. With an over-water length of 4.1 miles, the bridge will be one of the world's longest. Principal features include two separate cantilevers, each with a main span of 1,070 ft; 289-ft steel trusses; and 100-ft steel girder spans. The bridge was a project of the State of California Department of Public Works, Division of San Francisco Bay Toll Crossings, for which Norman C. Raab, M. ASCE, is projects engineer. Financing was by revenue bonds, the interest and principal, together with maintenance and operation costs, to be paid from tolls, which range from 75 cents to $5.00. Early phases of design and construction were described in "Civil Engineering" (April 1953, page 44, and April 1954, page 59).

Lake Pontchartrain Bridge Completed





Assembly line methods were used to manufacture and install precast piles, caps, and roadway slabs for the 24-mile causeway over Lake Pontchartrain at New Orleans, La. Contract cost was $27,600,000.

The 24-mile precast prestressed concrete causeway project across Lake Pontchartrain in New Orleans was opened to traffic on August 30 four months ahead of schedule. Ribbon-cutting ceremonies at each end of the world's longest highway bridge were climaxed by a barbecue for 4,000 in Fontainebleau State Park at Mandeville on the north shore of the lake in St. Tammany Parish.

The new causeway, which is 16 ft above lake level, is straight and level from end to end except for three 25-ft-high "humps" for the passage of small craft. Two double-leaf bascule spans provide 75-ft clear openings for larger craft.

A simplified design by the consulting engineers, Palmer and Baker, Inc., of Mobile, Ala., and a mass production assembly line technique developed by the Louisiana Bridge Co.—a joint-venture group of contractors, made up of Brown and Root, Houston, Tex., and T. L. James & Co., Ruston, La.—contributed to the rapid completion of the structure. The first pile was driven May 23, 1955, and the last floor slab placed on August 4, 1956.

The causeway consists essentially of 2,243 two-pile bents, supporting precast deck slabs 33 ft wide and 56 ft long. The 4,486 hollow concrete cylinder piles, a development of the Raymond Concrete Pile Co., were 54 in. in dia and were cast in 16-ft sections in the precasting yard near the north end of the bridge, then assembled in 90-ft lengths, and post-tensioned with twelve 12-wire cables. (See the article on centrifugally cast piles by M. M. Upson, M. ASCE, in the January 1953 issue, pages 46–49.)

In the $7,000,000 casting yard also were manufactured the caps and 185-ton deck slabs with plant and special forms devised by Ross White, M. ASCE, vice-president of Brown and Root, Inc., and by J. E. Walters, project manager for the joint-venture contractors. From the plant the elements were transported to location with a flotilla of 36 barges and seven tugs, and were assembled in position by a fleet of four 50-ton and one 200-ton derrick barges. An article on construction techniques by Myers Van Buren, M. ASCE, is scheduled for an early issue.

The contract price for the bridge, which provides a 28-ft clear roadway, was $27,600,000, or about $7.80 per sq ft of usable surface. Approach expressways at each end added $3,077,000. Forty-year toll-revenue bonds financed construction. De Leuw, Cather & Co., consulting traffic engineers for the project, prepared the toll schedule, which starts at $1.00 for automobiles and extends to $3.75 for four-axle trucks. Construction was supervised by William H. Smith, M. ASCE, Rear Admiral (ret.), of Palmer and Baker Inc., whose article in the May 1955 issue (pages 52–55) outlined the procedure contemplated at that time. The Pontchartrain Causeway is an important part of the $51,000,000 Greater New Orleans Expressway, which is still under construction.

Modular Building Council Endorsed by Architects

Plans for formation of a Modular Building Council were given a boost by recent action of the board of the American Institute of Architects, which has taken formal action supporting the proposed organization. The function of the council will be to bring together persons interested in improving dimensioning techniques in building. Its immediate goal will be to provide for development of a wider range of modular-size building materials.

The modular measure bases building dimensions and materials sizes on a standard 4-in. unit of measurement, so that parts will fit together easily and economically.

San Diego Water Authority Dedicates New Building

Additional space for the expanding activities of the San Diego County Water Authority is provided in a new $160,000 headquarters building, which was dedicated on July 12. Organized in 1944 to keep up with San Diego's ever-increasing water demands, the Authority has upped the supply of the area from 78,000 acre-ft per year to 140,000 acre-ft. One of its major projects has been bringing Colorado River water to the area, the first flow being delivered in 1947 and the "second barrel" project completed in October 1954. Future plans are tied up with development of the State Water Plan, particularly the Feather River Project, which will be the first unit in that plan.

At the dedication exercises Fred A. Heilbron, chairman of the board of the Authority, was given the title, "Mr. Water of San Diego County" and honored as one of the first to realize that San Diego would one day have to tap the Colorado River.

Chile Receives U.S. Funds For Nitrate Plant Expansion

Credits totaling $27.8 million to finance U.S. equipment and services required for modernization and expansion programs of nitrate companies in Chile have been announced by the Export-Import Bank. A $16 million authorization has been voted to the Anglo-Lautaro Nitrate Corp., largest nitrate-producing plant in the country, and one for $11.8 million to Cia Salitrera de Tarapaca y Antofagasta, the second largest producer.

The companies will purchase in the United States equipment to crush, process, and refine nitrate ores; power plants; construction and railroad equipment; and related engineering and technical services. Their over-all expansion programs, which are estimated at around $40 million, are expected to have a significant effect on the Chilean economy.

New Headquarters for Bureau of Standards

A 550-acre tract near Gaithersburg, Md., has been selected for relocation of the Washington laboratories of the National Bureau of Standards. The move will permit the Bureau to expand its facilities and to replace present structures, which over the past 50 years have become inadequate for current needs. The rural location will also remove the Bureau's work from the variety of mechanical, electrical, and atmospheric disturbances present in a city, which have an effect upon precise scientific measurements.

In addition to its Washington laboratories, the Bureau maintains a major research center in Boulder, Colo., and 20 widely scattered field stations.

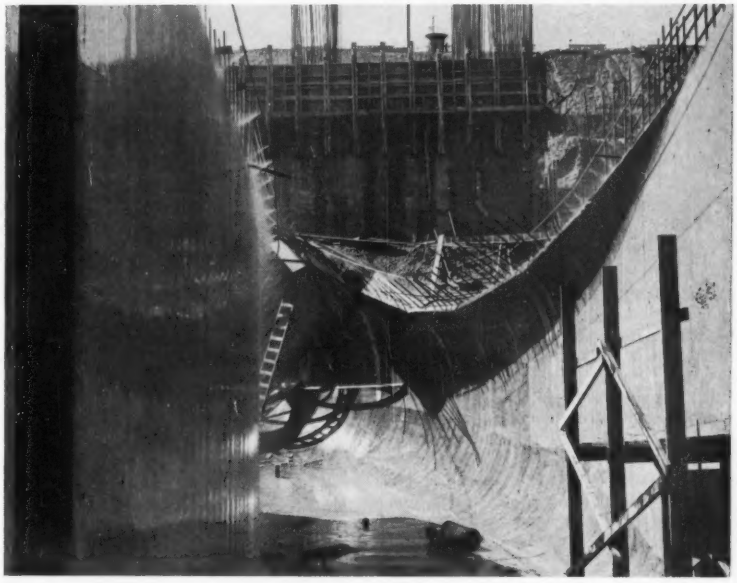
Engineers Chosen for Jordan-Arabia Railroad

Engineering plans for extending the Hejaz Railroad 500 miles south from Ma'an, Jordan, to Medina, Saudi Arabia, are being made by the New York civil engineering firm of Brown & Blauvelt. The existing road runs north from Ma'an to Damascus, Syria, ultimately connecting with the famed Berlin-Bagdad Railroad. Completion of the road, which will rehabilitate a line destroyed by Lawrence of Arabia during World War 1, will vastly improve transportation between Saudi Arabia, Jordan, and Syria. It is estimated that costs will run between $25 and $50 million, and that the entire project will take over three years.

Unusual Type of Convention Center Planned for Las Vegas

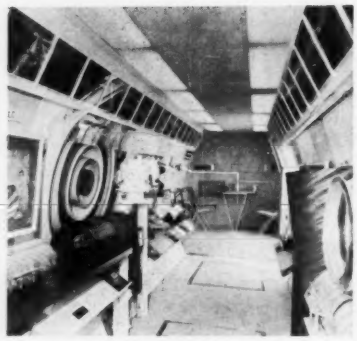
This large mushroom-shaped building is architect's rendering of $4,000,000 Clark County (Nevada) Convention Center, slated for erection in Las Vegas. Designed by Adrian Wilson & Associates, Architects and Engineers of Los Angeles, the projected structure includes many advanced engineering and design techniques and represents a radical departure from conventional civic building design. The structure will be of reinforced concrete, featuring a thin-shelled dome with thermo lightweight concrete. There will be no interior beams to obstruct vision, and up to 6,000 persons can be seated at one time. The building is the first unit in a planned civic center to cost from $15 to $20 million.

Steel Draft Tube Forms Expedite Barnhart Island Project



Use of steel draft tube forms on construction of Barnhart Island Power House permits important savings in labor. Designed and fabricated by Blaw-Knox, these forms were also used on Chief Joseph Dam in Washington and the Dalles Dam in Oregon. In order to form the proper tube shape, panels were made up into sections varying in length from 4 to 12 ft. Diameter of tube at throat is 24 ft, and depth of throat to elbow is 30 ft. At the point where the draft tube meets the two intermediate piers the height is $13\frac{1}{2}$ ft and width 59 ft. At discharge end the roof has an elevation of 24 ft and tube width is 60 ft. In forming the tubes the contractor pours the contoured slab first, following with the two intermediate piers, which are steel nosed. Then the discharge main piers, which constitute the inner wall of the draft tube, are formed and poured. After pouring the back half of the tube until it is completed, the contractor pours the roof section. This photo gives detailed view of main pier and draft tube after removal of steel forms. Contractor on the project was B. Perini & Sons.

Mobile Exhibit Shows Highway Construction Products



Traveling exhibit to acquaint engineers and others with Armco products that will be helpful in carrying out the unprecedented national highway program has been arranged by Armco Drainage and Metal Products, a subsidiary of Armco Steel Corp. Built in the shape of a huge corrugated metal pipe, such as the company produces for sewers, culverts, and other drainage work, the 35-ft-long "Steelmobile" houses sixteen exhibits of municipal construction products and services. It has taken to the road for a 50,000-mile tour of United States cities following a preview party at Middletown, Ohio.

Washington Headquarters For Traffic Engineers

The Institute of Traffic Engineers has moved its headquarters from New Haven, Conn., to Washington, D. C., where it opened new offices in the National Society of Professional Engineers Building this summer. After considering New York and Chicago for its new headquarters, the Institute decided on Washington as being closer to organizations with similar interests and objectives. According to President Charles W. Frisk, this liaison will be especially important "on the eve of the nation's greatest era of road building."

Increase in Brick Production Reported

A 14 percent increase in production of brick and structural tile in 1955 is reported by Robinson Newcomb, market analyst for the Structural Clay Products Institute. Noting that the increase was the greatest for any structural building material during the year, Dr. Robinson disclosed that a new postwar high of 9 billion brick equivalents was produced and that brick capacity went up 9.9 percent. For purposes of comparison he noted that during the same period there was a 4.7 percent increase in lumber production and a 9.4 percent rise in cement production. Cement capacity was up 7.4 percent, and steel capacity 2.1 percent.

Electronic Computer for Recording Streamflow Data

Engineering models of a surface water automatic computer are undergoing tests by the Geological Survey for processing river gage-height charts automatically, according to Secretary of the Interior Fred A. Seaton. Called "SURWAC," the device is a special-purpose data-processing machine rather than the "giant-brain" type of computer. Though largely electronic, it also has some mechanical components such as a scanning disk and chart-drive mechanism. The electronic components contain both digital and analog-type units.

SURWAC performs two separate computations on the input data, one to obtain values of daily mean gage height and the other to obtain values of daily mean discharge. After the two answers have been punched out, both tapes are run through a machine that automatically reads them and prints the daily averages in chronological order in separate columns. The daily figures produced on punch tape will be used later to make additional analyses of the data, such as low-flow durations, flood frequencies, and comparisons of the flows of adjacent rivers.

The Surface Water Branch of the Geological Survey keeps track of streamflow on all the nation's principal rivers as well as on typical smaller streams through a network of approximately 7,000 gaging stations. Data on water height are automatically charted at these installations, but the services of some 250 Geological Survey employees in 50 field offices are required to interpret the charts and prepare the data from them. When the new computer is in full operation, Mr. Seaton points out, it will be possible to make better utilization of such valuable technical manpower.

New Housing Starts Decline in July

Housing starts in July totaled 101,000 units, according to the U. S. Labor Department's Bureau of Labor Statistics. This figure was 3,000 less than the June starts, and 22,000 fewer than in July 1955. While the total of 676,200 units started thus far in 1956 (January through July) was 17 percent below the corresponding period of last year, it was within 2 percent of the seven-month totals for the years, 1951–1954.

The drop has been entirely in privately owned housing, which has accounted for almost all new dwelling units started in recent years. The 99,100 private dwelling units put under construction in July held the seasonally adjusted annual rate of private starts at the June level of 1,070,000, compared with an average of 1,120,000 for the first seven months of this year.

Tangents to One-Tenth Minute Developed

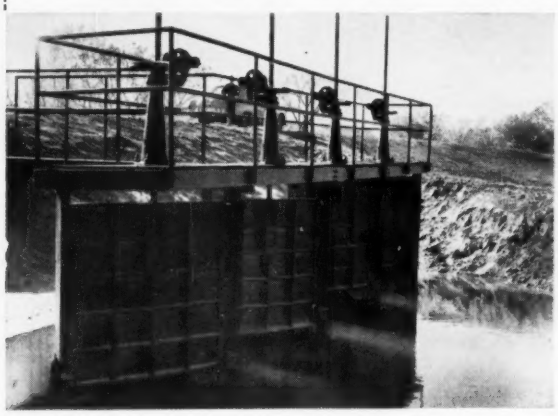
A new set of natural tangent tables that promises to be of value to surveyors and engineers has been developed by Boyce Engineering Associates. Specifically intended to aid in computing from field survey data obtained from surveying instruments which measure angular arcs to the one-tenth minute, the set consists of 91 single pages on heavy ledger stock durably bound.

Sets are priced at $12 each, or at $11 in lots of two or more. Inquiries should be sent to Russell I. Boyce, A.M. ASCE, 152 North Main St., Wallingford, Conn.

WATER CONSERVATION—Near Miami, Florida, Armco Roller Bearing Gates on the Miami Canal control water flow from Lake Okeechobee to the Atlantic Ocean.

IRRIGATION—These Armco Gates control irrigation water near Welton, Arizona. The Armco Slide Gate on the right is used for turnout to the field.

FLOOD CONTROL—Installed by U. S. Engineers, Armco Slide Gates provide flood control on the Tie Back Levee between Albuquerque and Bernalillo, New Mexico.



SEWAGE TREATMENT—Armco Flap Gate in Tulsa, Oklahoma, assures free outflow when open. When flow is reversed the gate closes tightly, preventing backflow.

These Armco Gates Make it Easy to Keep Water Under Control

Whatever the problem, you'll find an efficient yet low-cost Armco Gate to meet your water control needs.

Armco Slide Gates for light or heavy duty withstand face pressures up to 50 feet. They are supplied in a wide range of types and sizes. Flap Gates are available for circular openings to 120 inches in diameter, rectangular openings to 72 inches by 44 inches.

Other types include: Radial Gates, Roller Bearing Gates, and Meter Gates. For more data on Armco Gates, write us outlining your specific water control problems. Armco Drainage & Metal Products, Inc., 5716 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

Armco Water Control Gates

Remote Control TV Helps Supervise Dam Construction

A. R. Berry, project manager for B. Perini & Sons, prime contractor for the New York Power Authority on construction of St. Lawrence Power Project at Massena, N. Y., finds the remote-control closed-circuit television improves visual contact and surveillance of construction. Here he operates, by remote control, TV camera located atop 40-ft scaffold set up some distance from his office. Views of distant rock excavation, ditch drainage, and equipment placement are televised to TV monitor. System also makes it easy to watch blasting areas and other work hazards. Device is manufactured by Dage Television Division of Thompson Products, Inc., Michigan City, Ind.

N * G * Neare's N * COLUMN

R. ROBINSON ROWE, M. ASCE

The October meeting of the Engineers Club was poorly attended. The President blamed it on the Democrats, the Republicans, and competition from a national conclave of engineers.

"Even Cal Klater has already left for Pittsburgh," announced Professor Neare grimly, "so its Joe Kerr or else. Joe, did you find the height of Callisto's Needle from the 3 sets of shadows cast by two of Jupiter's 11 moons?"

"Twelve, you mean. Juno found another the other day."

"All right, 12, and maybe a 13th she hasn't found. So?"

"So my geodesy book didn't have equations for shadows on Jupiter, and I had to make up an analogous problem on Earth: find the height of a pole somewhere south of the equator from lengths of its shadow on the day of the equinox, observations being made in 3 equally timed pairs."

"Same problem," conceded the Professor.

"Then I can't do it unless you give me the latitude of the pole."

"You have to finagle that. On the celestial sphere (Fig. 1), Z is the zenith over Callisto and M,N are 3 positions of the 2 moons, arc MN being the constant α and arc OM the variable θ. Then if ϕ is the latitude of Z:

$$\cos\phi\cos\theta_1 = \cos ZM = a \quad \ldots\ldots(1a)$$

$$\cos\phi\cos(\theta_1 + \alpha) = \cos Zn = b \quad \ldots\ldots(1b)$$

where a and b are sines of the altitudes of the 2 moons when $\theta = \theta_1$. If you let c,d and e,f be corresponding sines at later times when $\theta = \theta_2$ and θ_3, the 6 equations can be reduced to the invariant relation:

$$\cos\alpha = \frac{a^2 + b^2 - c^2 - d^2}{2(ab - cd)} = \frac{a^2 + b^2 - e^2 - f^2}{2(ab - ef)} \quad \ldots\ldots(2)$$

"Looks like $1^1/_2$ equations in 7 unknowns," heckled Joe.

"Doesn't it! But $a = h/\sqrt{h^2 + 66^2}$, and similarly for the others, which would give us an equation in h alone. A very nice equation, except that it has 6 different radicals; squaring them out would make its degree 64.

"Now we can finagle. Assuming first, as for Io, that h = 132, compute a,b,c,d,e and f and substitute in (2), finding the inequality,

$$\cos\alpha \doteq .96060 < .97194$$

Guessing next that h = 140, find

$$\cos\alpha \doteq .96919 > .96895$$

giving us a straddle, from which we can interpolate $\cos\alpha = .96901$ for h = 139.834. Then, if you still want the latitude, you can go back to (1) and find $\phi = 6°41'S$.

"That might be a handy way of finding your latitude when you're stranded on a desert island with a calendar, a tape, a tree, and an uncalibrated hourglass, but much more practical is Al E. Dayde's new idea for subdividing Heron Acres. Buyers demand triangular lots for sprawling ranch-style homes. The subdivider wants exactly an acre in each lot. Al wants lot dimensions in whole numbers for cheaper drafting and staking. One idea is a lot with sides of 88, 1122 and 1166 ft, which satisfies buyers who prefer bowling and archery to tennis and badminton. Can you suggest a better one?"

[Tom J. Ogburn III brot us up to date on Jupiter's 12th moon. The new problem developed from a suggestion by Emerson J. Boyd, Jr. There are several good answers.]

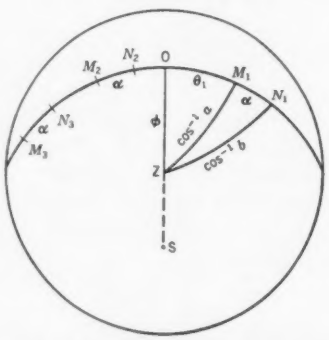
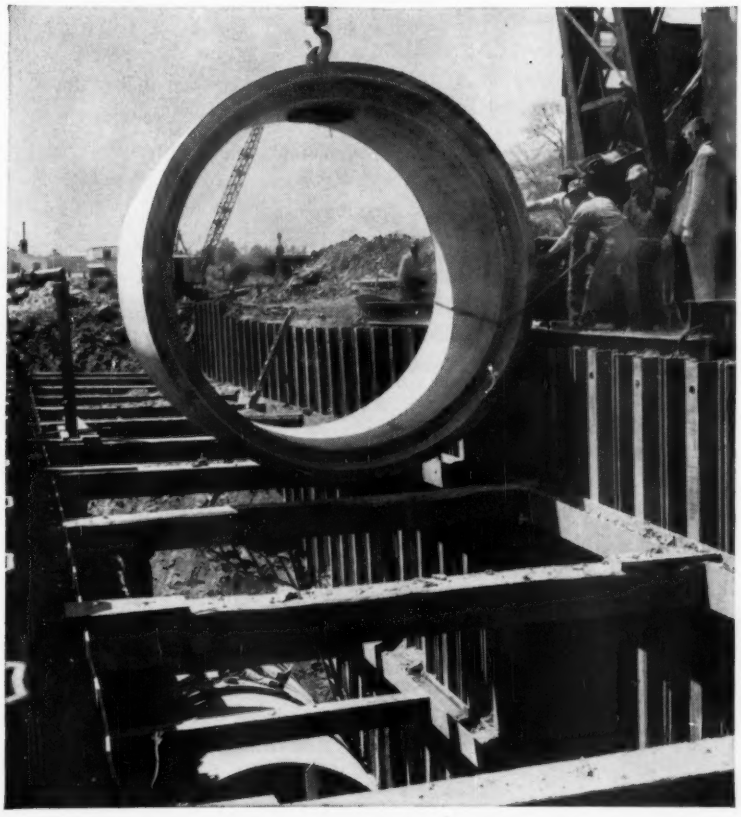


Fig. 1. Spheroid right triangles of altitude, hour angle and co-altitude definagle Callisto's height.

Technical Encyclopedia

Plans for publishing a multi-volume compendium of today's scientific and technological knowledge are announced by the McGraw-Hill Book Co. Called the "McGraw-Hill Encyclopedia of Science and Technology," the reference will be made up of several thousand alphabetically arranged and cross-indexed articles, written by acknowledged authorities in science and engineering. It will total some 7,000 over-size pages, probably bound in ten volumes, and will be well illustrated.

McGraw-Hill is establishing an editorial office in Charlottesville, Va., to house the staff required for the project and to take advantage of the research facilities at the University of Virginia. William H. Crouse, author of fifteen technical books, will be over-all editor. It is expected that about three years will be required for the work.



Louisville, Kentucky improves sewer service with gigantic

CONCRETE PIPE

The Louisville and Jefferson County Metropolitan Sewer District is spending $1⅓ million to improve sewer service in Louisville, Ky. Its new combination storm and sanitary sewer includes some of the largest concrete pipe ever placed in the city. This 11-ft. diameter pipe (see photos), manufactured in 6-ft. lengths, has a shell thickness of 12 in. The project required 700 ft. of this pipe.

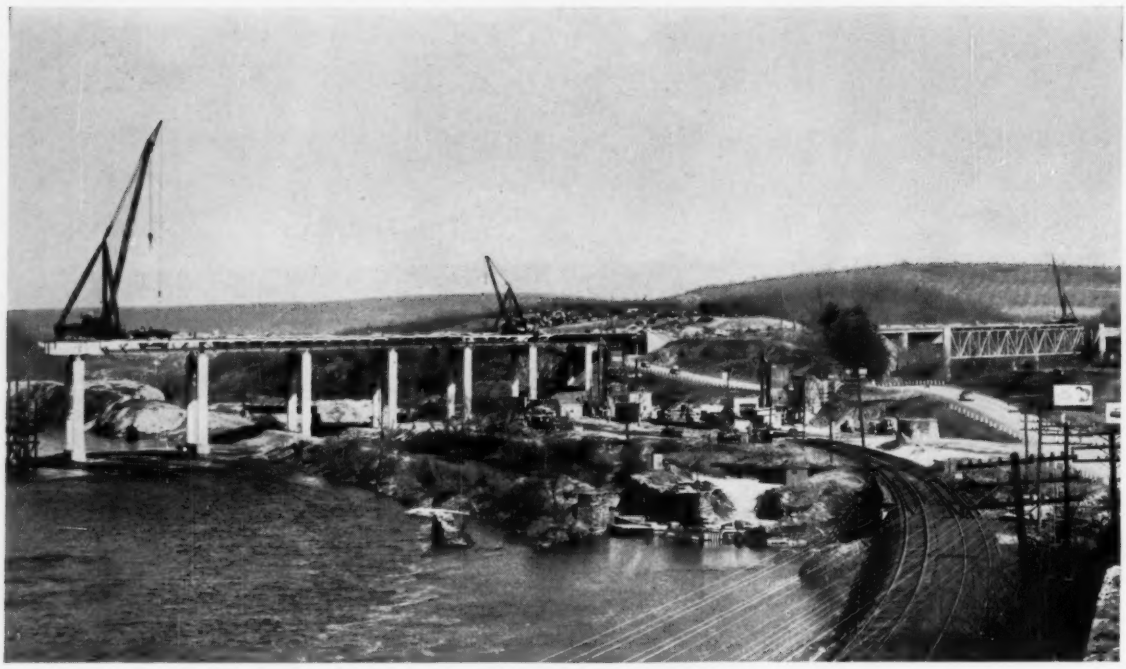
In addition, there are 200 ft. of 11-ft. diameter pipe cast monolithically on curves, 1657 ft. of precast 8-ft. pipe, 87 ft. of 8-ft. pipe cast monolithically on curves, and 974 ft. of 11-ft. x 16-ft. inverted egg pipe cast monolithically.

Like Louisville, hundreds of cities depend on concrete pipe sewers. These systems have demonstrated concrete pipe's rugged durability, great strength, maximum hydraulic capacity, minimum infiltration and leakage and unusual resistance to abrasion.

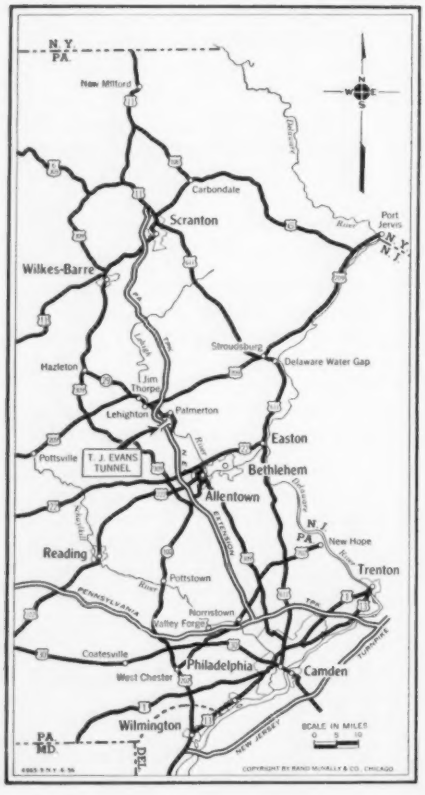
Concrete pipe sewers are moderate in first cost, require little maintenance and last for generations. The result is true ***low-annual-cost*** sewer service. Send for the free 48-page booklet, *"Concrete Sewers"*, distributed only in the United States and in Canada.

PORTLAND CEMENT ASSOCIATION
Department 10-13
33 W. Grand Ave., Chicago 10, Ill.

A national organization to improve and extend the uses of portland cement and concrete through scientific research and engineering field work



Turnpike Leaps the Lehigh



Two hours to Scranton! That's good news to Philadelphia area motorists, long accustomed to a tedious, time-consuming drive to Pocono Mountain resorts and Scranton-Wilkes-Barre industrial centers. But soon, with completion of the 110-mile Northeastern Extension of the Pennsylvania Turnpike, driving time will be halved or better.

The route of the extension carries it over and under many a crossing road and railroad right-of-way, and over numerous rivers. Bethlehem had a hand in quite a few of the required bridges, including the structures that vault the Lehigh River and Pohopoco Creek in two giant steps. The truss span, at right above, extends 920 ft over the Pohopoco. After a 700-ft stretch on land, continuous girders carry the broad highway another 1500 ft over the river and a double-track railroad.

Bethlehem's contracts covered fabrication and erection of bridge superstructures of various types in Montgomery, Carbon and Luzerne counties. The Northeastern Extension is a project of the Pennsylvania Turnpike Commission.

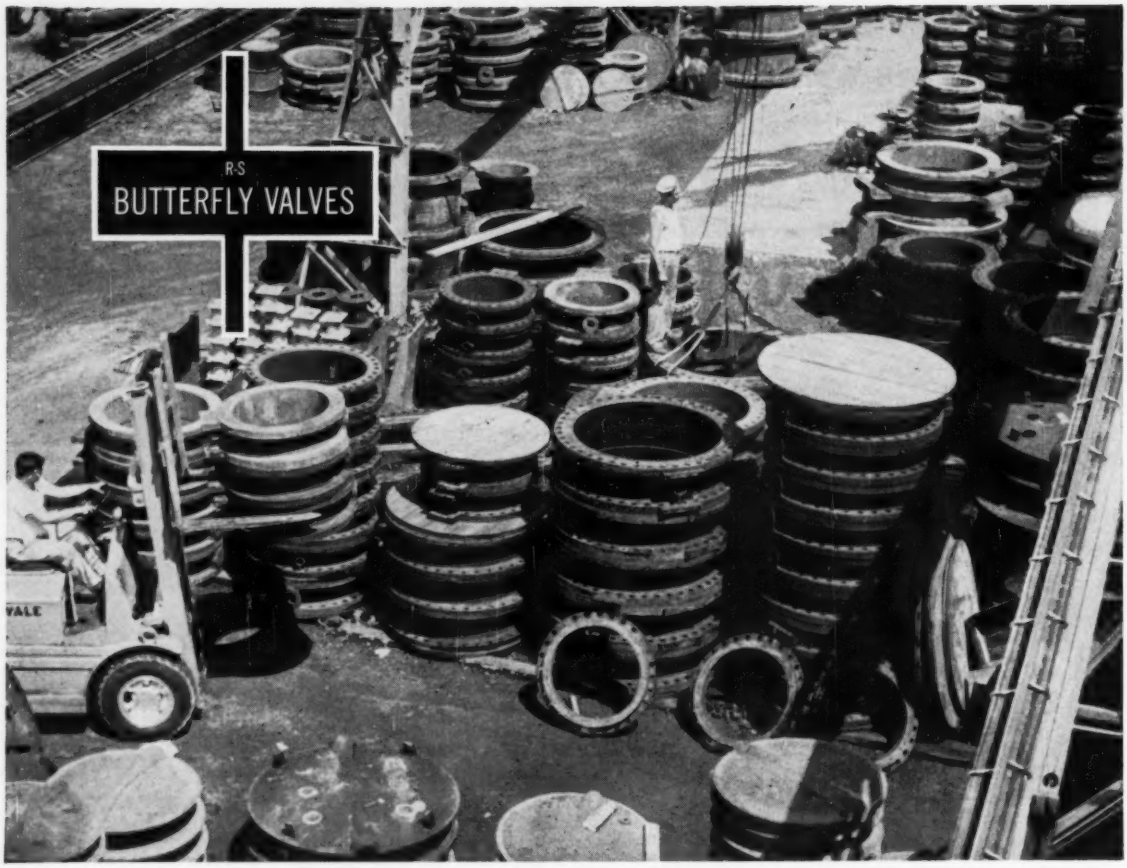
◀ **Beginning at a point on the turnpike's "main line" near Norristown, the Northeastern Extension provides a speedy, intersection-free route to Allentown-Bethlehem, Wilkes-Barre and Scranton, where it will terminate for the present.**

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL



In early July, SMS Plant #3 in Philadelphia began work on these orders. Castings for the valve bodies are shown here in storage prior to machining.

295 R-S BUTTERFLY VALVES IN $2,000,000 ORDER FOR PHILADELPHIA FILTRATION PLANTS

Two large valve orders, totaling some $2,000,000, were recently awarded to S. Morgan Smith and The A. P. Smith Manufacturing Co., of East Orange, N. J. These companies bid the valves for two Philadelphia municipal filtration plants, Queen Lane and Torresdale, as a joint venture.

A total of 295 R-S Rubber-Seated, A.W.W.A. standard Butterfly Valves, in sizes from 24 inches to 60 inches, and 632 gate valves, from 3 inches to 42 inches in diameter, are now being built by the two companies. The Queen Lane valves were purchased and will be installed by Roberts Filter Company and Huffman Wolfe Company, and the Torresdale valves by Ambrose-Augusterfer Company.

You can obtain full information on the complete SMS valve line – Rotovalves, Ball Valves and Butterfly Valves for all water works applications – by contacting our local representative or writing to S. Morgan Smith Company, York, Penna.

SMS

S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

HYDRAULIC TURBINES · GATES & HOISTS · TRASH RAKES · PUMPS · LIQUID HEATERS

HYDRODYNAMICS

ROTOVALVES · FREE DISCHARGE VALVES · BALL VALVES · CONTROLLABLE-PITCH SHIP PROPELLERS · BUTTERFLY VALVES

Rocky Mountain highway needs Skid-resistant pavement

Constructing skid - resistant Texaco Asphaltic Concrete pavement on U. S. Route 550, where this highway crosses the Molas Divide in Colorado at an elevation of 10,000 feet.

CONTRACTORS

Lowdermilk Brothers Construction Company, Denver, Colo.

Sterling Sand & Gravel Company, Fort Collins, Colo.

Completed Texaco Asphalt Concrete surface at the left and the 6-inch broken stone base at the right.

U. S. Route 550 crosses the Molas Divide near Silverton, Colo., about 10,000 feet above sea level. On the curves and grades of such a mountain highway, dependable skid-resistance is an exceptionally important quality in a pavement.

A hot-mix Texaco Asphaltic Concrete pavement has been constructed on this 6.8 mile section of US-550. Laid to a compacted thickness of two inches, this skid-resistant, rugged wearing surface is supported by a six-inch foundation of crushed stone. The Texaco asphalt surface and the stone base form a completely flexible pavement from the subgrade up, which is capable of absorbing heavy traffic year after year, with a minimum of maintenance.

Hot-mix Texaco Asphaltic Concrete is one of many heavy-duty, intermediate and low-cost types of construction for highways, streets, airports and parking areas obtainable with Texaco asphaltic products. Helpful information about the methods and materials recommended for all these types is supplied in two free booklets. Copies may be obtained without obligation from our nearest office.

ENGINEERING · RESEARCH · EDUCATION · THE ASPHALT INSTITUTE

MEMBER

THE TEXAS COMPANY, Asphalt Sales Div., 135 E. 42nd Street, New York City 17

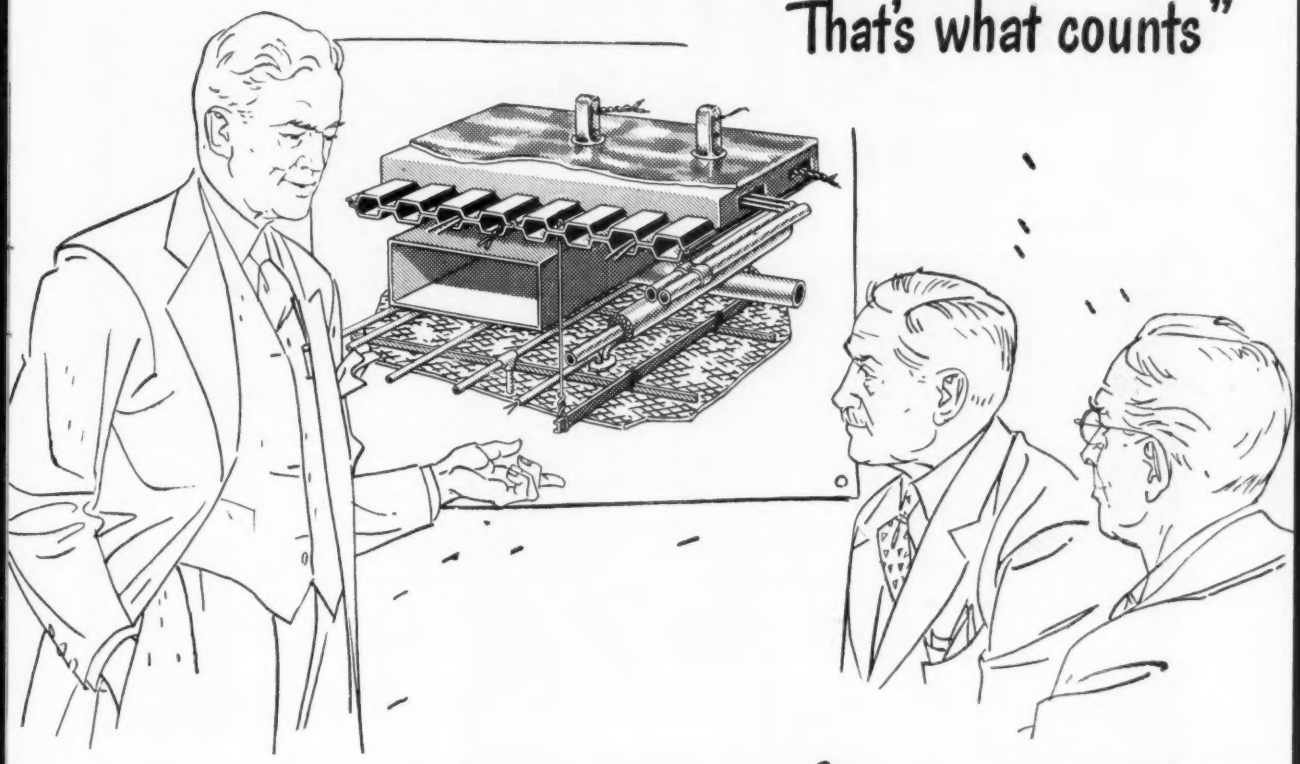
Boston 16 • Chicago 4 • Denver 1 • Houston 1 • Jacksonville 2 • Minneapolis 3 • Philadelphia 2 • Richmond 19

TEXACO

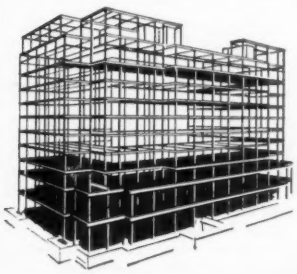
TEXACO ASPHALT

ASKED HOW SOON THE BUILDING COULD START, THE CONTRACTOR SAID,

"Steel construction gives a quicker finish date, That's what counts"



"Even if structural steel is tight, you have to allow time for demolition and excavation. By then the steel is ready. Todays finest buildings are being built with steel Q-Floors. They are the load-carrying members. The use of Q-Floors alone reduces construction time 20 to 30%.

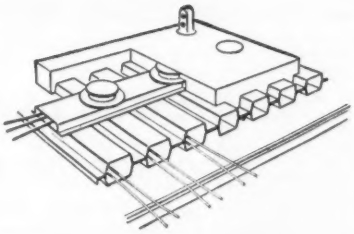


"You get a much quicker completion date. That's what decides how soon you can begin making money from your investment. Q-Floors go in fast —two men can lay 32 sq. ft. in half a minute. And construction is dry; no forms, falsework, or wet materials to hold back work. No fire hazard. Dry construction accounts for the 20 to 30% saving in time.

"Cost? Q-Floors cost less than the carpet to cover them! At most, the floor is always a small fraction of total cost, and yet the floors are what a building is for.

"You're making an investment for forty or fifty years. Q-Floors protect your investment over the decades against electrical obsolescence.

"Look at this picture of a section through the floor of a modern Q-Floor building. Suspended ceiling and all the building's mechanical equipment arteries are visualized in a condensed form. Steel Q-Floor cells are crossed over by headers. These carry wires for every



conceivable electrical service. An outlet can be established on every six-inch area, exactly where needed. The outlet calls for only a small hole. Takes actually a few minutes. No trench to dig. No muss or fuss. The entire building is protected against electrical obsolescence. Any number of new business machines can be introduced. Tenants can have as many changes, as fast as they want."

Write for the complete story—

Q-Floor*

*The original cellular steel floor . . since 1930 over 12,500 installations

H. H. Robertson Company

2443 Farmers Bank Building • Pittsburgh 22, Pennsylvania

In England—Robertson Thain Ltd., Ellesmere Port, Cheshire
In Canada—Robertson-Irwin Ltd., Hamilton, Ontario

NAME _____ TITLE _____

COMPANY _____

ADDRESS _____ CITY _____

DECEASED

John Thomas Ahearn (J.M. '48), age 35, job superintendent for the Hercules Concrete Pile Co., of West Palm Beach, Fla., was killed on July 3 while working on a highway bridge at Fort Lauderdale, Fla., when a crane came in contact with overhead wires. A 1948 graduate of the Thayer School of Engineering, Dartmouth College, Mr. Ahearn began his career in the Milwaukee, Wis., office of the Stone & Webster Engineering Co. For the past five years he had been project engineer for Greeley & Hansen Engineers, Chicago, working for much of this period on the Niagara purification plant at Niagara Falls, N. Y. He joined Hercules Concrete a short time before the fatal accident.

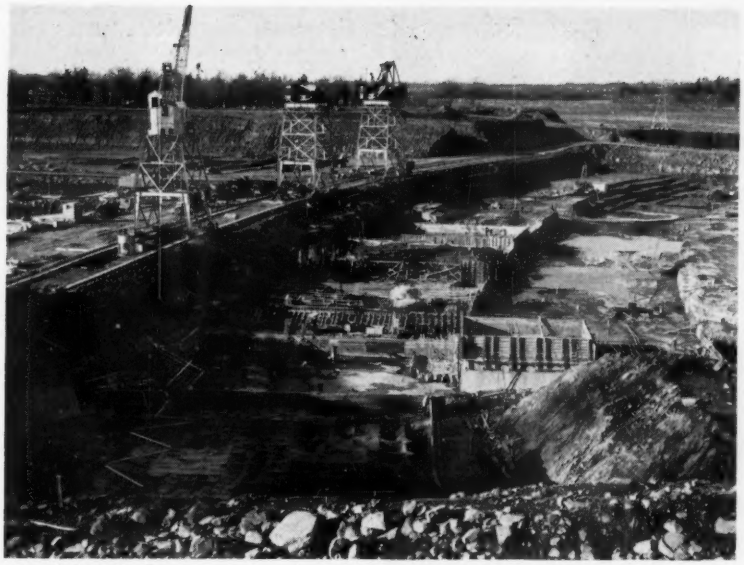
Harry Clow Boardman (M. '26), age 69, director of research for the Chicago Bridge & Iron Co., Chicago, Ill., died there on August 6. A 1910 civil engineering graduate of the University of Illinois, Mr. Boardman entered the employ of the Chicago Bridge and Iron Co. the same year. He left in 1916 to serve as major in the Field Artillery in World War I, and later was in business in Kansas City and taught at the University of Illinois. He returned to Chicago Bridge and Iron in 1926. Mr. Boardman had been president of the American Welding Society and chairman of the Welding Research Council and the ASME's Boiler and Pressure Vessel Code Committee.

H. C. Boardman

Daniel E. Brinsmade (A.M. '04), age 82, retired manager and director of the Shelton, Conn., office of the Bridgeport Hydraulic Co., died at his home in Shelton on May 3. A graduate of the Sheffield Scientific School of Yale University, class of 1896, Mr. Brinsmade soon thereafter entered the employ of the Housatonic Water Power Co. He served as president, treasurer, and manager of the Shelton Water Co., which later merged with the Bridgeport Hydraulic Co. Mr. Brinsmade retired as manager of the latter company last March.

Donald C. Creasy (A.M. '41), age 46, a civil engineer in the Navy Department's Bureau of Ordnance, Washington, D. C., died on August 11 in Charleston, S. C., while on vacation. His home was in Arlington, Va. A civil engineering graduate of Cornell University, class of 1931, Mr. Creasy worked in New York as an operation and maintenance engineer and as management engineer for the

(*Continued on page 108*)



FOUNDATION of Long Sault Dam where 700,000 yards of concrete will be poured by the contractor—Walsh, Perini, Morrison, Kiewit, Utah Companies, Massena, New York.

AGGREGATE TUNNEL CUTS COST OF VOLUME CONCRETE MIXING... ST. LAWRENCE SEAWAY PROJECT

Material handling is a major problem on projects such as the Long Sault Dam on the new St. Lawrence Seaway. Here is a job of such magnitude as to require more than 2400 cubic yards of concrete per day to keep the work rolling.

To handle the necessary aggregates, the contractor constructed, at some distance from the dam site, a tunnel within which a conveyor carries the aggregate to a batch concrete mixer. This tunnel, built right on the job with Commercial Shearing and Stamping steel liner plates, is large enough to accommodate the conveyor belt and walkway for feeder operators.

Placed at intervals in the tunnel roof are openings through which the aggregate flows by gravity from the stockpile directly overhead and which completely covers the tunnel. Feeders installed at intervals in the tunnel roof control the gravity flow of the aggregate from above.

Feeder operators working inside the tunnel control the material flow and selection of sizes to obtain the proper aggregate mixture reaching the conveyor. The belt carries the aggregate to the batch mixer for the addition of cement, water and mixing into concrete.

Commercial Shearing and Stamping liner plate was selected for this job because of its ability to withstand the most severe overhead loads, and to provide maximum protection from collapse and cave-in. In addition, the ease of constructing and disassembling Commercial liner plate tunnels make it possible to move or salvage the entire tunnel. This method of large scale aggregate handling, as done at the Long Sault Dam project, is being profitably used by contractors on other major projects.

Commercial Shearing and Stamping steel liner plate is available in a wide size and gauge range. For complete details on how Commercial can help solve your surface or sub-surface tunnel problems write to Dept. C-40, The Commercial Shearing and Stamping Company, Youngstown, Ohio.

CONSTRUCTION of aggregate tunnel is quick and simple. Workmen install Commercial's liner plates on this concrete foundation in trench.

TUNNEL is completed. Unskilled workmen have used only 7 inside bolts to hold each plate. Note aggregate feeder openings.

AGGREGATE, stockpiled on top of tunnel, flows by gravity onto belt conveyor inside tunnel as operators open feeder gates.

CONVEYOR emerges from tunnel (foreground) and feeds aggregate into batch mixer for final processing into concrete. Trucks then haul concrete to dam site without time loss.

Deceased

(*Continued from page 106*)

William A. White & Sons real estate firm. Entering the Navy in 1943 as a lieutenant (jg), he advanced to lieutenant commander in the gun mount and missile launcher branch of the Ordnance Bureau. In 1946 he went on inactive duty, but continued in the bureau as a civilian employee.

G. Cass Lightner (A.M. '13), age 69, retired civil engineer of Thetford Center, Vt., died recently. A specialist in industrial management, Mr. Lightner was in private business from 1932 to 1943 under the firm name of Lightner & Smith, manufacturers' sales agents of materials-handling equipment, with offices in New York. More recently he had been with the War Production Board in Washington, D. C., and commercial director of the Remote Control Division of American Type Founders, Inc., New York. As factory manager of the General Aviation Corp. from 1928 to 1932, he organized its Wheeling plant building and was superintendent of its Baltimore plant. Mr. Lightner held electrical and civil engineering degrees from the University of Michigan.

Roy Gillespie McGlone (M. '30), age 70, retired chief of the Operations Division of the Corps of Engineers, Dallas, Tex., died at his home there on July 3. Mr. McGlone became connected with the Corps of Engineers in 1908 and remained in it until his retirement early this year. In his 48-year tenure with the Corps, Mr. McGlone filled many important assignments, and served as a civilian and engineer officer in both World Wars. He was a graduate of Purdue University, class of 1907.

William Norman McLeod (M. '52), age 71, retired consultant on assignment to the International Bank for Reconstruction and Development in England, died at his home in Farnham, Surrey, recently. Mr. McLeod graduated from Glasgow University in 1908, and in the same year was appointed to the Indian Service of Engineers by the Secretary of State for India. He was in the Indian Service until 1940, serving in the Irrigation Branch of the Punjab Public Works Department and in the Hydroelectric Branch. From 1940 to 1949 he was with Sir Alexander Gibb and Partners, consulting engineers of London, on assignments in Turkey, Iran, and England. He became connected with the International Bank in 1949.

William Meadowcroft (M. '35), age 80, retired civil engineer of New York City, died there on August 7. Mr. Meadowcroft graduated from Harvard College in 1901. In his early career he was with the Metropolitan Water Works in Boston and with the U. S. Government in the Philippines. Later he was with the New York City Board of Water Supply, and from 1925

until his retirement in 1935 he was with the American Abrasive Metals Company of New York.

Rudolph Frank Mischke (A.M. '49), age 61, since 1945 plant superintendent for the Capitol Iron Works Co., of Topeka, Kans., was fatally stricken at his work recently. For twenty-four years Mr. Mischke was associated with the Carnegie-Illinois Steel Co. of Chicago on structural steel design. From 1934 to 1942 he was superintendent of steel fabrication and erection of bridge and waterworks structures for the Chicago Bureau of Engineering.

Charles F. Morse (M. '12), age 85, retired New York State highway construction engineer, died in Patchogue, N. Y., on August 4. Mr. Morse had been in highway construction for more than 38 years—for 25 years as assistant engineer for the highway department in Suffolk County. He retired in 1940. Early in his career, Mr. Morse was associated with the Metropolitan Park Commission of Boston, Mass., and later was with the New York City Board of Water Supply. He studied at Massachusetts Institute of Technology.

Samuel G. Neff (M. '55), age 57, engineer with the U. S. Army Corps of Engineers at Portland, Oreg., died recently. A graduate of the University of Wyoming, class of 1922, Mr. Neff joined the Corps of Engineers in 1928. He served as area engineer in the Kansas City District for five years. Transferring to Fort Peck Dam, he was area engineer, construction engineer, and assistant superintendent of construction on the Fort Peck Dam. He had also been chief of operations and construction on Denison Dam, and chief of construction of the Newfoundland District. More recently he had been resident engineer for the Corps on McNary Dam in Oregon, and at the time of his death was chief of the Operations and Construction Division in the North Pacific Division at Portland.

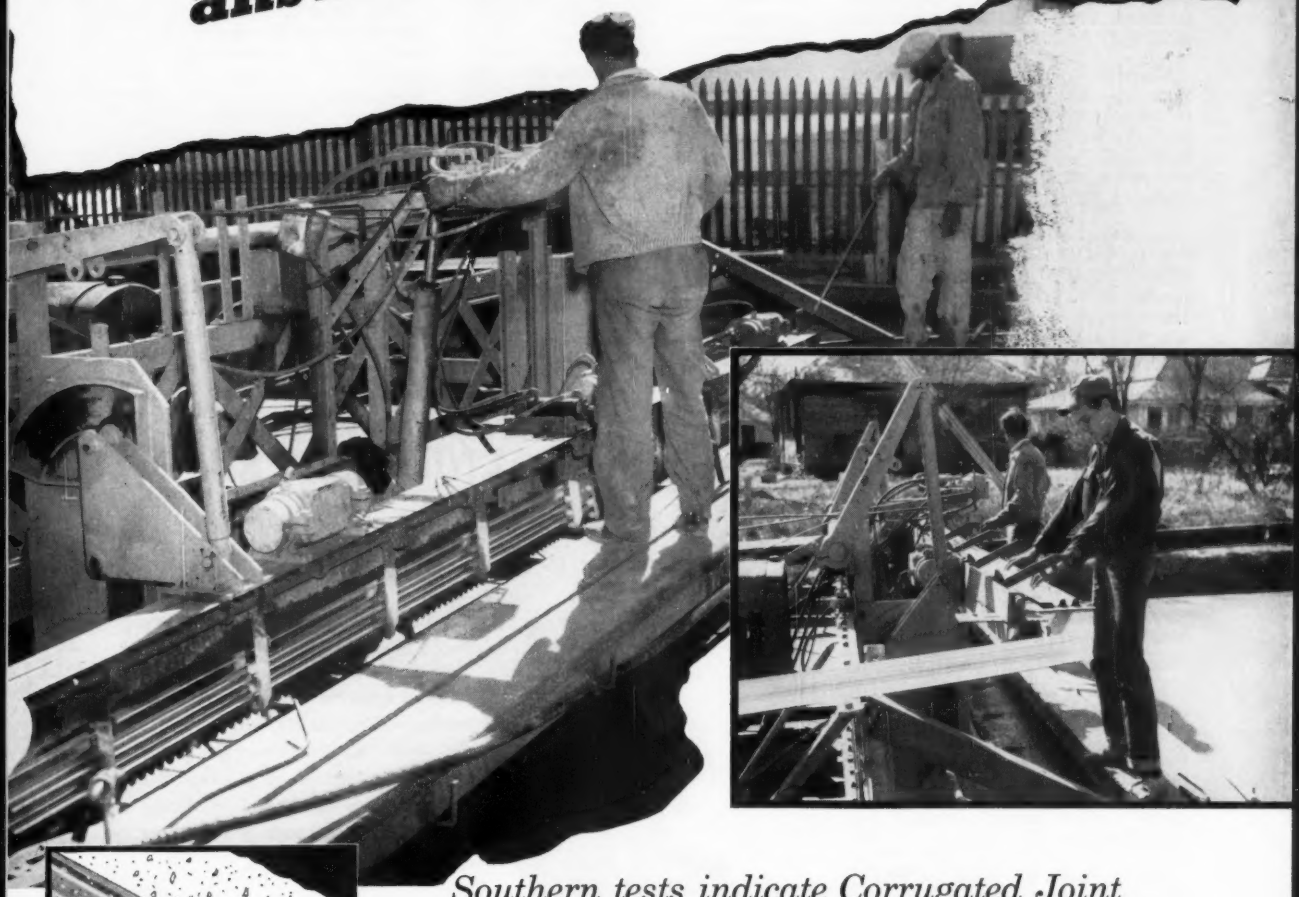
George T. Richards, Jr. (M. '52), age 63, architectural and civil engineer with E. I. du Pont de Nemours & Co., died in Wilmington, Del., on July 26. A civil engineering graduate of Princeton University, class of 1914, Mr. Richards spent twenty years of his career in the construction industry—associated with George A. Fuller, H. K. Ferguson and others. He had a consulting practice for six years. Joining the DuPont Company as a designer in 1940, he was engaged in engineering for the company's atomic energy work for the government from 1951 on. He was instrumental in the company's work on design of the Savannah River plant of the AEC.

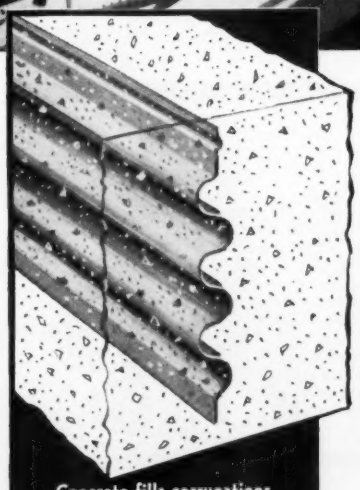
Carl Theodore Schwartz (M. '31), age 78, professor emeritus of civil engineering at New York University, died at his home in Greer, S. C., on June 28. Professor Schwartz was graduated from Cooper Union in 1903 and obtained a degree in civil engineering from Lehigh University two years later. He began his teaching career at Cooper Union, then joined the faculty of N. Y. U. in 1920 as a lecturer. He became professor of civil engineering in 1931, retiring in 1942.

Leon A. Smith (M. '38), age 66, Superintendent of Water Works and Sewerage for Madison, Wis., for 40 years, died suddenly in St. Louis on May 10, while attending the AWWA Convention. He was a 1912 graduate of the University of Wisconsin.

John Zurek (M. '55), age 49, general construction inspector with the Federal Housing Administration at Indianapolis, Ind., died at his summer home at Nashville, Ind., on April 20. At the time of his death Mr. Zurek had just completed plans for establishing a consulting engineering and architectural practice at Bloomington, Ind., where he made his home. A graduate of Illinois Institute of Technology, class of 1936, he was employed for seven years by the Chicago Bridge and Iron Co. Mr. Zurek joined the Federal Housing Administration at the close of the recent war, in which he served with the Corps of Engineers in Europe. In his work with the FHA he served as federal inspector on construction of multiple housing projects.

Is Corrugated Joint the answer to better highways?





Concrete fills corrugations making a water tight joint that is free to rotate and still maintain load transfer

Southern tests indicate Corrugated Joint best permits expansion and contraction while still providing maximum load transfer!

● Considerable experimentation in the states of Louisiana and Texas has proved some rather interesting points that make the corrugated joint attractive to other highway engineering groups. For example, the corrugated joint permits full joint rotation—slab expansion-contraction action—while providing maximum load transfer at all times. Corrugations actually lock slabs together, yet every point on the joint is always free to rotate. Too, the joint is watertight in itself, without the need for joint compounds that require maintenance and produce certain rough riding qualities. But perhaps the most important advantage of all is the ease of installation. Flex-Plane has been providing all the mechanized equipment since the beginning of the tests, and has recently developed a machine that enables two men to handle the entire jointing operation, making it most economical to use.

For further information write Dept. C-56, Flexible Road Joint Machine Company, Warren, Ohio.

THE FLEXIBLE ROAD JOINT MACHINE COMPANY

7700 THOMAS ROAD · WARREN, OHIO

9893

Non-ASCE Meetings

American Concrete Institute. 1956 Regional Meeting to be held at Mount Royal Hotel, Montreal, Canada, October 24–25. Further information from Robert E. Wilde, ACI, 18263 West McNichols Road, Detroit 19, Mich.

American Concrete Pipe Association. Sixth Annual Short Course School of Instruction at the Chase Hotel, St. Louis, Mo., October 29–31. Information from Howard F. Peckworth, Managing Director, ACPA, 228 North LaSalle Street, Chicago 1, Ill.

American Institute of Steel Construction, Inc. Thirty-fourth annual meeting at the Greenbrier Hotel, White Sulphur Springs, W. Va., October 29–November 1. Information from L. Abbett Post, executive vice-president, A.I.S.C. 101 Park Avenue, New York 17, N. Y.

American Public Health Association. Eighty-fourth annual meeting at Atlantic City Convention Hall, Atlantic City, N.J., November 12–16. Information from Amerian Public Health Association, 1790 Broadway, New York, N. Y.

American Society of Mechanical Engineers. Twenty-second National Exposition of Power and Mechanical Engineering at the New York Coliseum, New York City, November 26–30. Information from International Exposition Company, 480 Lexington Ave., New York 17, N. Y.

Building Research Institute. Two-day research correlation conference on "Windows and Glass in the Exterior of Buildings" at the United States Chamber of Commerce, Washington, D. C., November 14–15. Information from Building Research Institute, 2101 Constitution Avenue, Washington 25, D. C.

Conference on Statistical Methods for the Civil Engineer. At Case Institute of Technology, Cleveland, Ohio, October 23. Further information from Statistics Conference, Case Institute of Technology, Cleveland 6, Ohio.

Energy Resources Conference. First annual Energy Resources Meeting, sponsored by the Denver Chamber of Commerce at the Cosmopolitan Hotel in Denver, Colo., October 29–31. Information from Energy Resources Conference, c/o the Denver Chamber of Commerce, 1301 Welton Street, Denver 4, Colo.

Engineers Joint Council. Pan-American Federation of Engineering Societies (UPADI) will hold its Fourth Convention in Mexico City, October 8–12. Information from Brig. Gen. S. E. Reimel, Committee on International Relations, EJC, 29 West 39th Street, New York 18, N. Y.

Engineers' Council for Professional Development. Twenty-fourth annual meeting at the Engineering Society of Detroit, 100 Farnsworth Avenue, Detroit, Mich., October 25–26. Hotel headquarters at the Statler Hotel. Information from S. L. Tyler, Executive Secretary, ECPD, 29 West 39th Street, New York 18, N. Y.

Instrumentation Conference. Fifth Annual Instrumentation Conference to be held at Louisiana Polytechnic Institute, Ruston, La., November 1–2. Information from Virgil Orr, Publicity Chairman, 5th Annual Instrumentation Conference, Louisiana Polytechnic Institute, Ruston, La.

International Road Federation. Regional Conference of International Road Federation at Guatemala City, Guatemala, November 26–28. Information from IRF, 1023 Washington Building, Washington 5, D. C.

National Safety Council. Annual convention of the National Safety Council at the Conrad Hilton Hotel, Chicago, Ill., October 22–26. Information from Jack Horner, Director of News, National Safety Council, 425 No. Michigan Ave., Chicago, 11, Ill.

U. S. Naval Civil Engineering Research and Evaluation Laboratory. Symposium on Prevention of Equipment Deterioration at the Laboratory, Port Hueneme, Calif., October 23–25. Information from Officer in Charge, Code 200E4, U. S. Naval Civil Engineering Research and Evaluation Laboratory, Construction Battalion Center, Port Hueneme, Calif.

RECENT BOOKS

(added to the Engineering Societies Library)

Basic Engineering Sciences, Solution to Problems

Detailed solutions to selected problems from Part II of the N. Y. State professional engineering examinations given over the past ten years through February 1956. The fields covered include mechanics, machine design, hydraulics, thermodynamics, and electricity. Illustrative diagrams have been used wherever they are necessary. The author is William Glendinning. (Fourth Edition, Available through author, 5123 Bell Boulevard, Bayside, New York. 122 pp., paper. $3.00.)

Careers in Engineering

This booklet, by Lowell O. Stewart, gives information on the nature of the engineering profession; the apitudes, interests, and personality necessary for the study of engineering; factors that determine success in college and after; and the engineer's fields of work. The engineering fields are considered from three points of view: by degree-granting departments of universities, by industries employing engineers, and by function such as design, construction, research, etc. Aids to counselors and teachers and other books on the profession are listed in an appendix. (The Iowa State College Press, Press Building, Ames, Iowa. 105 pp., paper, third edition, 1956. 105 pp. $1.25)

Physics and Chemistry of the Earth, Volume 1.

This first volume of a new series of surveys of advances in the fields of geochemistry and geophysics contains critical reviews on the following topics: The origin of the solar system; temperatures within the earth; radioactive methods for determining geological age; seismology and the earth's interior structure; hydrodynamics of the earth's core; investigations under hydrothermal conditions; the geochemistry of the halogens; and geochemistry in the U.S.S.R. A list of references accompanies each review. Edited by L. H. Ahrens, K. Rankama and S. H. Runcorn. (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y. 1956. 317 pp., bound. $8.00.)

Principles and Techniques of Applied Mathematics

An analysis by Bernard Friedman of the methods developed in theoretical studies which can be used to systematize the solution of problems likely to be met by applied mathematicians, physicists, and engineers. In addition to providing a thorough grounding in linear spaces, spectral theory of operators, Green's functions, eigenvalue problems, and partial differential equations, the book demonstrates that logical analysis of a problem leads to the proper method for its solution. (John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 315 pp., bound. $8.00.)

The Structure of Turbulent Shear Flow

This is an attempt to develop a consistent view of the nature of turbulent flow by considering the properties of simple forms of turbulent flow, and to apply this view to the analysis of the more common types of turbulent shear flow. The analysis covers jet, wake, and boundary-layer flow as well as flow in pipes and channels and shear flow between rotating cylinders. A bibliography is included. The author is A. A. Townsend. (Cambridge University Press, 32 East 57th Street, New York 22, N. Y. 315 pp., $7.50.)

Technical Education

This study—by P. F. R. Venables—of the present state and likely development of British technical education includes two chapters devoted to engineering education. One of these is a general survey, the other a discussion of the relationship of university engineering education to technical education. Most of the book, however, is a critical survey covering curricula, selection of students, teaching staffs, and other aspects of education in technical institutes. Special studies of education for the building trades and of art, commercial, and science education are also included. (Essential Books, Inc., 16-00 Pollitt Drive, Fair Lawn, N. J., 1955. 645 pp., bound. $6.75.)

Surveying: Instruments and Methods for Surveys of Limited Extent.

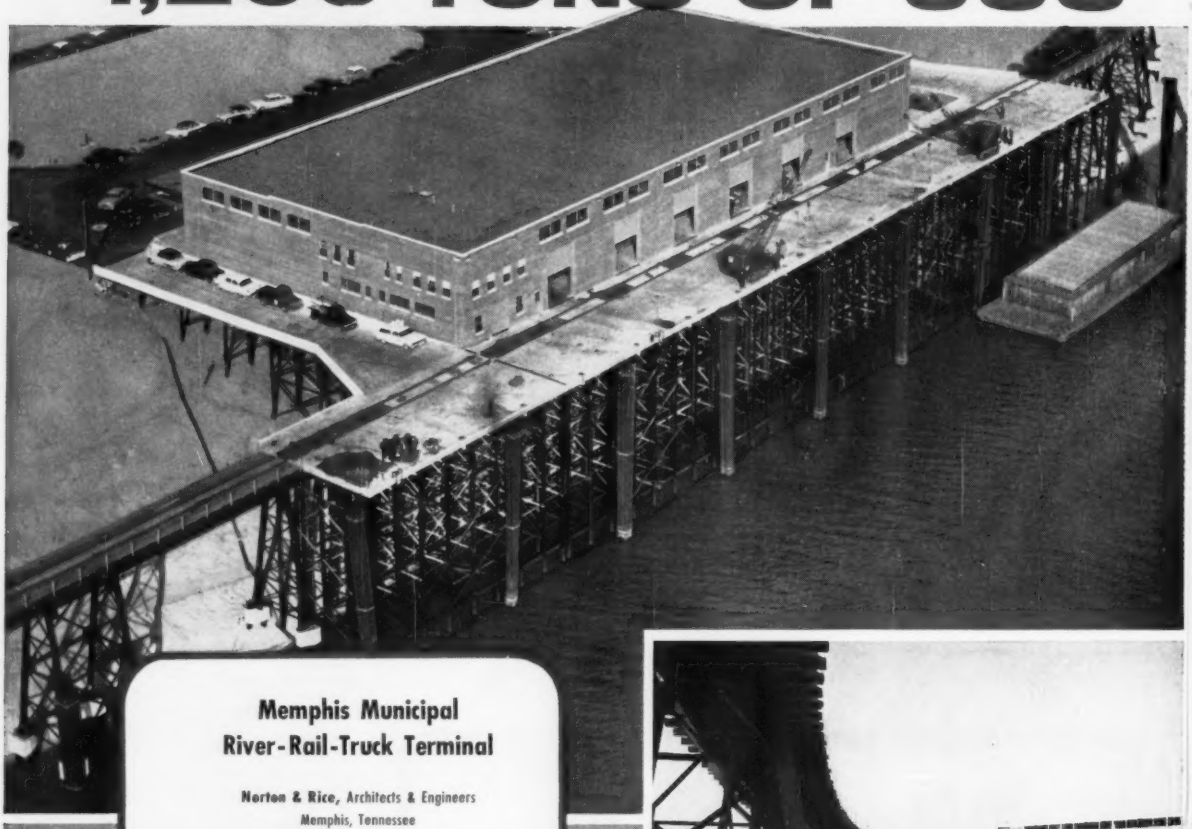
A basic text by Philip Kissam covering fundamental operations and such procedures as line and grade for construction, optical tooling, transit-stadia and plane-table surveying, drawing of maps, record keeping, and the elements of the use of aerial photographs. A selected list of films and film strips is included. (McGraw-Hill Book Company, Inc., 330 West 42nd St., N.Y. 36, N.Y. Second edition. 1956. 482 pp. Bound, $5.75.)

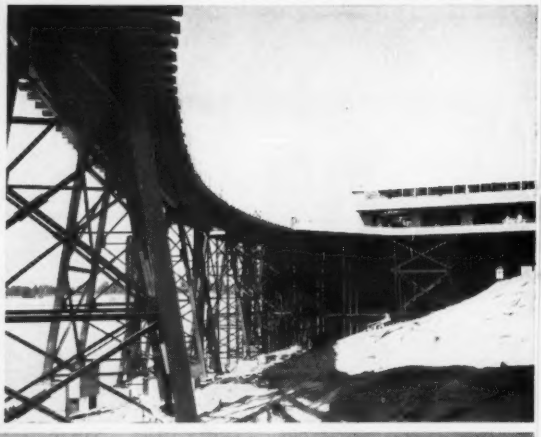
Resistance of Materials

Part I of this standard text—by F. B. Seely and J. O. Smith—consists of the basic topics usually included in the subject: relations among loads, stresses, and deformations; stresses in beams; statically indeterminate members; dynamic loads, etc. Part II deals with such addi-

(*Continued on page 119*)

New Three-Way
securely and
1,200 TONS OF USS





Memphis Municipal
River-Rail-Truck Terminal

Norton & Rice, Architects & Engineers
Memphis, Tennessee

Consolidated Contractors, General Contractor
Memphis, Tennessee

Harry B. Hunter & Associates, Structural Engineer
Memphis, Tennessee

Terminal at Memphis permanently built on *Steel* BEARING PILES

Hailed as the city's greatest single project in the last 50 years, Memphis' new $1,400,000 public river-rail-truck terminal is the first phase in the development of a vast industrial harbor area.

Built by the Memphis and Shelby County Port Commission, this modern terminal consists of a large transit shed containing 28,800 square feet of floor space, a paved dock, 400′ long x 40′ wide, and a railroad trestle running 1,800′ along the waterfront. In addition, a truck and rail loading platform will run entire length of the transit shed in the rear.

All of these facilities are permanently and safely founded on 1,084 USS Steel Bearing Piles varying in height from 35′ to 75′, some of which were driven to a depth of 38′.

Proved Structurally and Economically Sound

USS STEEL BEARING PILES have been proved structurally and economically sound in a wide variety of projects. On large jobs and small. In fresh water and in salt water. Under buildings, bridges, piers, docks, dams and viaducts. They can support unusually heavy loads per pile . . . and resist high bending stresses. They effectively resist lateral displacements . . . penetrate with remarkable ease through all types of unstable sub-soil materials, to provide a secure means of supporting foundations at great depth.

Their great capacity for high unit loads, both vertical and horizontal, means fewer piles and fewer driving operations for a given load. USS Steel Bearing Piles are readily handled in the field with ordinary equipment, and are easy to splice, eliminate jetting, and withstand rough handling.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA. • UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS Steel H-Bearing Piles

UNITED STATES STEEL

ENGINEERING SOCIETIES

PERSONNEL SERVICE, INC. (AGENCY)

NEW YORK	CHICAGO	DETROIT	SAN FRANCISCO
8 W. 40th ST.	84 E. RANDOLPH ST.	100 FARNSWORTH AVE.	57 POST ST.

This placement service is available to members of the Four Founder Societies. If placed as a result of these listings, the applicant agrees to pay a fee at rates listed by the service. These rates—established to maintain an efficient nonprofit personnel service—are available upon request. The same rule for payment of fees applies to registrants who advertise in these columns. All replies should be addressed to the key numbers indicated and mailed to the New York Office. Please enclose six cents in postage to cover cost of mailing and return of application. A weekly bulletin of engineering positions open is available to members of the cooperating societies at a subscription rate of $3.50 per quarter or $12 per annum, payable in advance.

Men Available

CIVIL ENGINEER, J. M. ASCE; B.S.C.E.; 25; 3 years of experience in planning, maintenance and design, in Navy Civil Engineer Corps. Desires position offering variety of engineering experience. Available November 1956. Location desired, New York City area. C-157.

CIVIL ENGINEER, A.M. ASCE; B.S.C.E.; 42; married; licensed engineer; 12 years' general building engineering and structural design. Complete structural design, multi-story structures; design and construction of residences and buildings; interested in administrative, supervisory, or managerial position. Fluent in Spanish; will consider foreign employment. Location desired, East or Southwest. C-158.

FIELD OR SALES ENGINEER, J. M. ASCE; B.C.E.; 26; 3 years' construction and inspection of military hospitals; 8 months' structural design and drafting of bridge components. Location desired, Metropolitan New York. C-159.

SOILS ENGINEERS, J.M. ASCE; 27, single; B.S.E.; S.M.E., major in soil mechanics. Completing 3 years in Navy Civil Engineer Corps, 1 year in airfield construction, and 18 months in public works office. Desires position with construction or consulting firm associated with soils and foundation engineering. Available late November. Location, New England or West Coast. C-160.

CIVIL ENGINEER-ADMINISTRATOR, A.M. ASCE; B.S. in civil engineering; 38; successful record in highway design and administration from designer to principal project engiaeer. Field and office experience with consultants. Completed $15 million of design in past years. Available October. Location, New York Metroplitan area or foreign. C-161.

FIELD ENGINEER, J.M. ASCE; BCE; 23; 2 years' construction supervision in Germany of housing projects, bunkers, and road nets. Office experience in 7R/C design, as well as surveying and soil testing. Location: Europe. C-163.

Positions Available

CIVIL ENGINEERS, graduates, young, interested in a future in heavy civil and mechanical construction. Should have above average academic records and from 1 to 5 years practical experience. Should have completed military service. Must be willing to relocate anywhere in the Eastern half of the U.S. Salary open. Company headquarters in western Pennsylvania. W-3027.

FIELD ENGINEER, graduate civil, for field inspection of Air Force installations, new construction and rehabilitation. Will involve electrical, plumbing and heating as well as general construction. Salary to $9,000 a year. Location, New York, N. Y. W-3764.

SANITARY ENGINEER for the operation and maintenance of a new water purification plant; graduate sanitary, with at least 5 year's experience in the operation and maintenance of a rapid-sand filtration plant of the gravity type with an approximate capacity of 15 M.G.C. or larger. Experience should include operation and maintenance of chemical feeders for the application of alum, lime, activated carbon and chlorine by equipment manufacturer by Builders-Providence, Inc.; the operation and maintenance of Venturi meters with their indicating and recording instruments and transmitters of electric type, filter controllers, loss of head gages, wash water gage, operation tables, etc.; physical, chemical, bacteriological and microscopical examinations of water; preparation of reports, etc. Salary open. Location, South America. F-3772.

SOILS ENGINEER with experience in highways or a recent graduate with a master's degree in soils engineering. Salary open. Location, Connecticut. W-3803.

PROJECT ENGINEER with some administrative experience. Graduate of a southern engineering school, with experience in southern industry and construction, including the construction of modern textile plants, desired. Duties will include client contact and handling of large projects from the beginning, coordinating construction, architectural, electrical and mechanical, and all essential services. Salary open. Location, South. W-3810.

CIVIL ENGINEERS. (*a*) Assistant Resident Engineer, graduate C.E., ASCE member, with at least 10 years excavation, foundation, waterproofing, and general heavy construction experience. Salary, $10,000 a year. (*b*) Section Engineer, civil graduate, with at least 5 years field engineering experience in heavy construction and industrial building work. Salary, $6,500–$7,200 a year. Location, eastern Maryland. W-3818.

CIVIL ENGINEERS. (*a*) Engineers experienced in highway surveys and design. (*b*) Soils Engineer with field and laboratory experience in soils mechanics. (*c*) Structural Designers and Detailers. Salaries open. Positions permanent. Location, Eastern U.S. W-3854.

SUPERINTENDENT for construction and maintenance department. Registered engineer, with considerable U.S. construction experience, capable of supervising all major construction, repairs, and maintenance of housing and commercial structures. Salary, $12,000 a year. Location, Chile. F-3855.

ENGINEERS. (*a*) Design Engineer, graduate C.E., 35–40, with at least 5 years' experience in structural design on industrial buildings, reinforced concrete, structural steel and other materials. Some drafting as well as supervision of small group. Design includes project work. Salary, $7,200–$9,000 a year. (*b*) Structural Draftsman, 35–40, with about 5 years' experience on industrial building design. Salary, $6,000–$7,800 a year. Location, New York, N. Y. W-3860.

RESIDENT ENGINEERS, civil or mechanical graduates, with at least 6 years field engineering and supervisory construction experience covering manufacturing plants, industrial and commercial buildings, for field supervision of large construction projects as owner's representative in responsible charge. Salary, $7,500–$10,000 a year. Various locations of projects as components of a continuing nationwide program of plant expansion. W-3865.

CIVIL AND SANITARY ENGINEERS for a consulting firm; capable of report writing, design of sewers, pumping stations, treatment plants, water supply systems, structural and hydraulic designs; also draftsmen for such work. Salaries open. Location, Boston, Mass. W-3881.

SENIOR STRUCTURAL DESIGN ENGINEER with at least 5 years' supervisory design, job layout and industrial construction coordination experience. Salary, $9,100 a year. Location, Albany, N.Y. area. W-3882.

CONSTRUCTION ENGINEER, B.S. in M.E., E.E., or C.E., with 10 years' plant engineering experience (preferably steel, aluminum or brass mill); 5 years' supervisory experience. Will plan, estimate, and direct construction projects ranging from small equipment modification to installation of entire metal-working-process facilities. Must be able to supervise work of outside contractors to include maintaining schedules and quality of work. Salary, $10,000–$12,000 a year. Company will pay half placement fee when applicant reports for work; the other half after six months of employment. Will pay expenses for interviews; moving expenses are negotiable. Location, Pennsylvania. W-3891.

FIELD ENGINEER with experience on highway and bridge construction for thruway project. Salary, $6,000 a year. Location, Connecticut. W-3926.

CHIEF DESIGN ENGINEER, civil or structural graduate, 40–55, for review and approval of designs and drawings for large continuing nationwide building program. Minimum of 15 years' progressive experience with large consulting-engineering firm on manufacturing plants and commercial buildings with responsible charge as project engineer, including coordination of mechanical and electrical engineering. Salary, $13,000–$16,000 a year. Location, upper New York State. W-3932.

ASSISTANT DISTRICT SUPERINTENDENT, civil graduate, preferably with P.E. license, and at least 5 years industrial and commercial building construction, equipment installation, and maintenance experience. Salary, $6,000–$7,000 a year. Location, New York, N. Y. W-3936.

DISTRICT MANAGER with civil engineering training, estimating, and sales experience in the building and heavy construction fields, to sell

(*Continued on page 118*)

Men and Jobs Available

(Continued from page 117)

fabricated plant and reinforced concrete products. Salary, $6,000–$8,000 a year, plus bonus. Location, New York, N. Y. W-3950.

DESIGNERS, civil graduates, with 10 to 15 years' experience in the design of airfields, roads, etc. Work will include design of pavements, grading plans, drainage structures, etc. Salary, $8,320 a year. Location, Virginia. W-3953.

JUNIOR ENGINEER, degree in civil, sanitary, or public health engineering. Salary, $4,650–$5,760 a year. Location, Long Island, N. Y. W-3971.

CONSTRUCTION SUPERINTENDENT, C.E., to supervise construction of new building materials for manufacturer of building materials. Must have at least 4 years' good solid field work supervising industrial construction. Salary to $10,000 a year. Employer will pay placement fee. Location, Illinois. C-5385.

FIELD ENGINEER, civil engineering trainee, to inspect work and check contractors in building materials line. Salary to $6,500. Employer will pay placement fee. Location, Illinois. C-5386.

CHIEF SANITARY ENGINEER, B.S. in C.E. or Ch.E., 35 or over; preferably 10 years experience in design of water and sewer systems. Knowledge of surveying, swimming pools. Will be in complete charge of design of water distribution, water supply, and water treatment systems and sewage collection and treatment systems for municipalities, subdivisions, schools, institutions, etc. Car required. Salary, $10,000 or better. Employer will pay placement fee. Location, western Illinois. C-5470.

RESIDENT ENGINEER on rockfill dam, graduate C.E. or equivalent, 40–60. Will interpret plans and specifications, supervise field engineering staff, act as liaison between contractor, client, and consulting engineers. Will have complete administration of field office for duration of 4 years. Salary, $18,000–$21,840, depending on experience. Employer will pay placement fee. Location, Iraq. C-5487.

DEPUTY RESIDENT ENGINEER, graduate C.E. or equivalent, 35–60. Must have at least 10 years' dam construction experience including at least one rockfill project and have knowledge of rockfill dam construction, foundations, and geology. Will supervise field engineering and act as resident engineer in latter's absence. Four years' duration. Salary, $15,000–$16,800 a year. Employer will pay placement fee. Location, Iraq. C-5488.

Applications for Admission to ASCE, Aug. 18–Sept. 8, 1956

Applying for Member

ROBERT ALFRED BRIGGS, Detroit, Mich.
WARREN WILLIAMS CLARK, Salem, Ore.
GERALD WELLINGTON FERGUSON, Kansas City, Mo.
ROBERT CARLTON GISH, Denver, Colo.
MYRON GOLDSMITH, San Francisco, Calif.
LYMAN PERKINS HOUGHTON, Denver, Colo.
DEWEY WOODRUFF JOHNSON, Chicago, Ill.
JOHN POPE KOCH, Dallas, Tex.
BENJAMIN ELDER LOFGREN, Sacramento, Calif.
RALPH HOWARD MAJOR, Chicago, Ill.
WILLIAM ROSCOE MOORE, Richmond, Va.
ROBERT BARRY NICHOLS, Knoxville, Tenn.
JOHN RANNELLS, Philadelphia, Pa.
JOHN EDWARD SLATTERY, Chicago, Ill.
WILLIAM PHILIP SOMERS, Bountiful, Utah.
MERCER VINCENT THOMPSON, Rolla, Mo.
ROBERT TAYLOR TINDAL, Tuscaloosa, Ala.
OTTO CARL VON SEGGERN, San Francisco, Calif.

Applying for Associate Member

HERMAN ROBERT AMBERG, Camas, Wash.
IRVILLE L. ABBOTT, Sacramento, Calif.
JAMES MOYES BELL, New York, N. Y.
LAWRENCE ROBERT BLAIR, Hayward, Calif.
BASHIR AHMAD CHOWDHRY, Sargodha, West Pakistan.
RICHARD WALLACE CHRISTIE, New York, N. Y.
RUSSELL EMMETT CURTIS, Lincoln, Nebr.
ZAVEN DAVIDIAN, Beirut, Lebanon.
JOHN L. DZEDZY, Morristown, Pa.
WILLIAM JESSE EVANS, JR., St. Clair Shores, Mich.

(Continued on page 120)

Recent Books

(Continued from page 113)

tional topics as composite beams, unsymmetrical bending, continuous beams, and elastic vibration of load-resisting members. (John Wiley and Sons, Inc., 440 Fourth Ave., New York 16. 459 pp., bound. $6.50.)

The Analysis of Structures

This book by Nicholas J. Hoff for graduate students and practicing engineers consists of four parts: the principle of virtual displacements; the minimum of the total potential; the calculation of buckling loads; and complementary energy and least-work methods. In each of the four parts fundamental information is presented in the opening sections, and succeeding sections are devoted to applications to various structures and to the more advanced principles. Examples of the applications discussed are torsion of an engine mount for a radial airplane engine, deflections of a sandwich-type beam, and large deflections of a flexible cable. (John Wiley & Sons, Inc., 440 Fourth Avenue, New York 16, N. Y., 1956. 493 pp., bound, $9.50.)

The Growing Shortage of Scientists and Engineers.

The speeches and panel discussions recorded in these proceedings deal with the present and future supply and demand for scientists and engineers, the efficient utilization of scientific manpower, means for increasing the supply of engineers, the encouragement of scientific talent, the failures of scientific education, and methods for improving science teaching. Proceedings of the Sixth Thomas Alva Edison Foundation Institute, November 1955. (New York University Press, Washington Square, New York 3, N. Y., 1956. 132 pp., $4.00.)

Versuche Zur Festigkeit der Biegedruckzone

A description and evaluation of the results of laboratory tests on the strength and deformation of eccentrically compressed rectangular specimens of unreinforced concrete under short-time loads. The study is extensively illustrated by representative graphs and diagrams. The author is H. Rüsch. (Deutscher Ausschuss für Stahlbetonbau, Heft 120, Wilhelm Ernst und Sohn Verlag, Berlin. 94 pp., DM 14.00.)

World Symposium on Applied Solar Energy, Proceedings (November 1955)

The nineteen technical papers included in these proceedings deal with such subjects as solar machines and stills, high temperature furnaces, the heat pump, water heaters, cooling with solar energy, algae culture, electricity from the sun, and residential uses of solar energy. The proceedings also include a panel discussion on solar house heating and two round-table discussions devoted to the architectural problem of solar collutors and the future of applied solar energy. Published 1956 by Stanford Research Institute. (Available from Association for Applied Solar Energy, 204 Heard Building, Phoenix, Ariz. 304 pp., bound, $5.00.)

Library Services

Engineering Societies Library books may be borrowed by mail by ASCE members for a small handling charge. The Library also prepares bibliographies, maintains search and translations services, and can sopply photoprint or microfilm copies of any items in its collections. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York, 18, N.Y.

Applications

(*Continued from page 118*)

JERROLD MILTON GAYNER, Sacramento, Calif.
JOHN LELSIE HALEY, Emporia, Kans.
WHIPPLE M. JONES, Mobile, Ala.
CHADWICK BOYD LEIGHTON, Palisades, Idaho.
LOYAL GERALD LUNDEGARD, New York, N. Y.
EZRA MEIR, Durham, N. C.
WILLIAM CLINTON MORRIS, Baytown, Tex.
JOHN MURPHY, Wellington, New Zealand.
DON HAMILTON NANCE, Sacramento, Calif.
PAUL EVERETT NYLANDER, Lincoln, Nebr.
MICHAEL BERNARD O'SULLIVAN, Lumpur, Malaya.
ROBERT LEE PARE, North Scituate, R. I.
JOHN PATRICK PRENDERGAST, Santa Clara, Calif.
DONALD LEROY SPELLMAN, Sacramento, Calif.
CLIFTON ALLEN TANNAHILL, Houston, Tex.
FREDERICK FOOTE TAUSSIG, Turner, Kans.
REED ALDEN TROXEL, Toledo, Ohio.
MICHAEL ALEXANDER TUPIN, Toledo, Ohio.
ALFRED DINGEE VORES, III, Rolla, Mo.
GEORGE LLOYD WHITAKER, Lincoln, Nebr.
EDWIN GRIFFITH ZACHER, San Francisco, Calif.

Applying for Affiliate

GUNNAR MAGNUS BRUNE, Fort Worth, Tex.

Applying for Junior Member

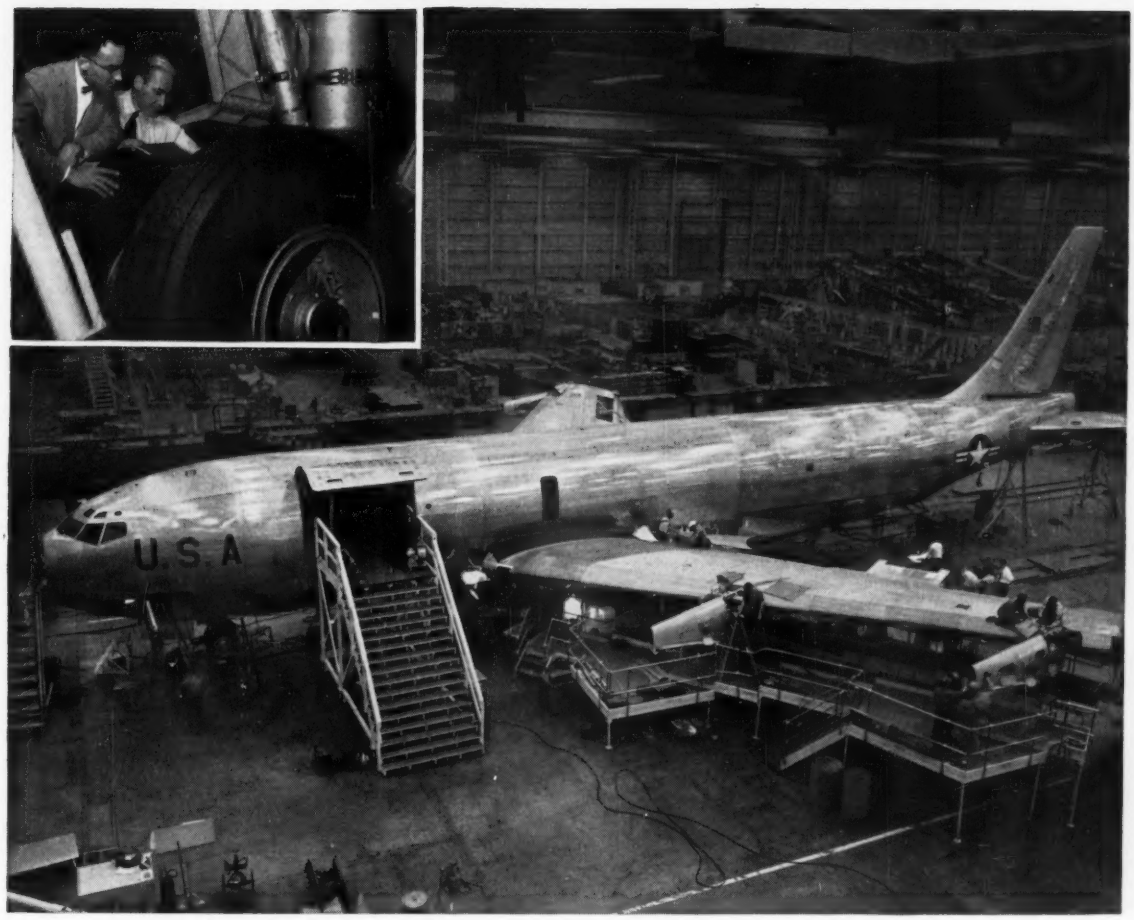
KARL LEWIS DEITZ, Little Rock, Ark.
ROBERT STEVEN DOWD, Denver, Colo.
WALTER FONTAINE EVANS, Washington, D. C.
CLIFFORD CHARLES HERDMAN, New York, N. Y.
PETER LLEWELLYN LECOUNT, New Kensington, Pa.
EDWARD CHUJI MASUOKA, San Francisco, Calif.
CLEMENTE PEREDA-BERRIOS, Caracas, Venezuela.
GAIL STUART PRESTON, Los Angeles, Calif.
JAMES BASNETT RUNRAJ, Georgetown, British Guiana.
JAMES ERNEST SAWYER, Albany, Ga.
HARLEY ROBERT WOODWORTH, Sr., Sacramento, Calif.

Positions Announced

Army Corps of Engineers. The Eastern Ocean District, with headquarters in New York City has openings for engineers on construction of military airbases and other installations in the Eastern Ocean District. Applicants must be firmly grounded in scientific principles and seeking an opportunity to apply them to construction problems. Basic salaries range from $4,480 to $8,990 per annum. Tours of duty for overseas areas range from 12 to 24 months. Standard Form 57 obtainable from any post office or Federal Agency, should be completed and submitted to the Civilian Personnel Officer, Eastern Ocean District, Corps of Engineers, U. S. Army, 346 Broadway, New York 13, N. Y.

Army Corps of Engineers. The South Atlantic Division has responsibility for the construction of several large facilities for the Department of the Army and the Air Force in connection with the guided missiles and related projects development program. Opportunities are currently available in the civil and construction fields. Engineers should contact the Division Engineer, South Atlantic Division, Corps of Engineers, P.O. Box 1889, Old Post Office Building, Atlanta, Ga.

U. S. National Museum. In expanding its curatorial staff in preparation for increased exhibits and undertaking an extensive program of research in the History of Engineering, the Smithsonian Institution has a vacancy for either a man or woman in the Division of Mechanical and Civil Engineering for an associate curator, principally concerned with the history of engineering. The position is under Civil Service GS-9 to GS-11, salary $5,440 to $7,465, depending upon the qualification and experience of the applicant. A doctor's degree is desirable but not a prerequisite. Candidates should send a brief resume of their education and experience to Robert S. Woodbury, Curator, Division of Engineering, Smithsonian Institution, U. S. National Museum, Washington 25, D. C.



Another engineering first—the Boeing jet transport-tanker

The KC-135, shown on the production lines of Boeing's Transport Division, is America's *first* jet transport-tanker. It gives the Air Force a refueling craft that matches the performance of today's jet-age fighters and bombers. In its transport role, the KC-135 becomes our defense forces' first aerial carrier with the speed and altitude for jet-speed operations.

Civil engineers at Boeing—who helped turn out 888 propeller-driven tankers in this same plant — are now working full time on jet-powered aircraft. Boeing's big and growing backlog of orders creates openings for many more civil engineers.

Civil engineers at Boeing enjoy a great variety of production assignments: tool and jig design, liaison, construction of new facilities. They perform supervisory roles overseeing production processes and methods, and they have an opportunity to pioneer in the adaptation of many new materials and facilities. Besides the KC-135, civil engineers helped produce other advanced Boeing aircraft: the B-52 eight-jet intercontinental bomber, the 707, America's *first* jet airliner, and the BOMARC Missile System.

Here's some measure of your advancement potential at Boeing: during the last 10 years, the number of Boeing engineers has increased 400%. With that kind of growth, there are always opportunities for advancement. They could be *your* opportunities, for Boeing promotes from within. Every six months a merit review gives you an occasion for recognition, advancement, increased income.

At Boeing, you live in progressive, young-spirited communities, with good housing and recreational activities. You work with men outstanding in the world of engineering, on projects of tremendous importance to your country. You look forward to one of the most liberal retirement plans in the industry. There's job stability, and a limitless future, at Boeing — in production, and in design and research as well. If this is what you're looking for, get started by mailing the coupon — today!

- **JOHN C. SANDERS, Staff Engineer — Personnel**
  Boeing Airplane Co., Dept. D-56, Seattle 24, Wash.
- **F. B. WALLACE, Staff Engineer — Personnel**
  Boeing Airplane Co., Dept. D-56, Wichita, Kansas
- **A. J. BERRYMAN, Manager — Administration**
  Boeing Airplane Co., Dept. D-56, Melbourne, Fla.

Mail this coupon to the address above from which you desire further information about advantages of a Boeing career.

Name _____

College(s) _____ Degree(s) ____ Year(s) ____

Address _____

City _____ Zone ____ State _____

Telephone number _____

BOEING

Aviation leadership since 1916

SEATTLE, WASHINGTON WICHITA, KANSAS
MELBOURNE, FLORIDA

CATALOG DIGESTS of ENGINEERING and INDUSTRIAL interest

1 ABRASIVE TREAD PLATE

Aluminum Co. of America—A booklet 596 is offered detailing the advantages of using abrasive tread plate. Applications, fabricating data and illustrations are given.

2 ADJUSTABLE CURVE DRAFTING INSTRUMENT

Albert G. Daniels—A 4-page folder with photographs, specifications and prices illustrating the adjustable Curve Drafting Instrument is offered. These handmade instruments, placed on the market over ten years ago, continue to provide the draftsman with an easy, convenient way to obtain curves of long radius, and also irregular curves. Calibrated scale indicates actual radius of curvature or degree of curvature.

3 AERIAL MAPPING

Aero Service Corporation—Literature covering new and more economical applications of varied aerial mapping services is offered. These include aerial photography, topographic and planimetric maps from an aerial photographic base, precise aerial mosaics, and plastic relief maps. Services discussed are used in highway design, plant engineering, industrial development, city planning.

4 AERIAL SURVEYS

Alster & Associates, Inc.—Latest information on aerial surveys is offered in a booklet "Topographic Mapping From Aerial Photography." Fully illustrated, this booklet describes how maps are made from aerial photographs and analyzes uses and advantages of the topographic, planimetric and mosaic maps the firm produces. Explains how the photogrammetric method reduces survey costs as much as 75% compared to conventional ground survey methods.

5 AERIAL SURVEYS

Hycon Aerial Surveys Inc.—An up-to-date brochure, titled "Progress through Photogrammetry and Geophysics" is highly informative. Consisting of 18-pages, it describes the latest methods and instrumentation utilized by Hycon in all phases of its operations. Price $.25.

N.B. There is a charge for this book. Make checks payable to Hycon Aerial Surveys, Inc.

6 AERIAL SURVEY NEWS

Hycon-Aerial Survey Inc.—Published the first day of each month, a newsletter is available which carries items on equipment, methods and material relative to the activities of Hycon Aerial surveys and general information on projects in process.

7 AIR-COOLED CONDENSER

Halstead & Mitchell—A remote air-cooled condenser is described in detail in a four-page booklet. A self-contained unit with no water needed, the condenser features an efficient core design which allows high air volumes at low speed. A table of performance data for the various size units is given as well as dimensions and weights.

8 AIR-ENTRAINED CONCRETE

Lone Star Cement Corp.—A 36-page booklet, illustrated with 11 graphs and tables and 86 photographs, contains technical and practical information as to desirable air content, increased durability and resistance to frost action, improved workability, reduced bleeding and easier finishing of concretes made with Lone Star air-entraining Portland cement and "Incor" air-entraining high early strength Portland cement. Of special value is definite information for use in designing air-entrained concrete mixes.

9 AIRPLANE DESIGNED FOR COMFORT

Aero Design & Engineering Co.—A colorful folder illustrating the many outstanding features of the Aero Commander 560A. Aero engineers have made possible many comfort, utility and flexibility features by re-designing the length of the airplane.

10 ALUMINUM GRATING

Kerrigan Iron Works, Inc.—A 4-page brochure of engineering data and a safe load table on spark-proof Kerrigan Weldforged aluminum grating-open flooring, and stair treads is offered. Light weight, non-magnetic, non-corrosive, this grating has no maintenance cost and its high strength insures many years of service. It is now manufactured in types and sizes of grating for every need; steel, stainless, monel, aluminum, riveted, extra close spaced and serrated.

11 ALUMINUM PIPE RENTAL SERVICE

L. B. Foster Co.—Cut your costs on temporary surface pipe lines by taking advantage of a complete rental service on all wanted sizes of aluminum pipe and couplings. A four-page leaflet "Rental or Sale—Aluminum Pipe Lines" discusses this in detail.

12 ASPHALT HANDBOOK

The Asphalt Institute—This 304-page manual, Construction Series 81, is the primer for all personnel engaged in asphalt construction. Among the subjects covered are: Uses of Asphalt; Tests; Paving Equipment; Design, Manufacture and Inspection of Plant Mixes; Design of Asphalt Pavements for Highways, and Airports; Asphalt Useful Tables; Specialty Uses; and Maintenance and Resurfacing. Price $1.50.

N.B. There is a charge for this book. Make checks payable to The Asphalt Institute.

13 ASPHALT LINERS

W. R. Meadows Inc.—A new brochure H-56 is now available fully describing their "Hydromat" asphalt liners. These liners are a flexible, impermeable liner material especially designed to provide a practical and economical product for the complete containment of water wastes, sludges and sewage in irrigation projects, soil conservation programs, industrial reservoirs and waste-control ponds, municipal water and sewerage projects, residential pools and military installations.

Mail This COUPON To-day

CIVIL ENGINEERING Date.....
33 West 39th St., New York 18, N. Y.

Please have the literature indicated by the circled Catalog Digest numbers in the October 1956 issue sent to me without obligation.

1	2	3	4	5*	6	7	8	9	10	11	12*	13	14	15
16	17	18	19	20	21	22*	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37*	38	39	40	41	42	43	44	45
46	47	48	49	50	51*	52	53	54	55*	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
76	77	78	79	80	81	82	83	84	85	86	87	88	89	90*
91	92*	93	94	95	96	97	98	99	100	101	102	103	104	105
106	107	108	109	110	111	112	113	114	115	116	117	118	119	120
121	122	123	124	125	126	127	128	129	130	131	132	133	134	135
136*	137	138	139	140	141	142	143	144	145	146	147	148	149	150
151	152	153	154	155	156	157	158	159	160	161	162	163	164	165
166	167	168	169*	170	171	172	173	174	175	176	177	178	179	180
181	182	183	184	185*	186	187	188	189	190	191	192	193	194	195
196	197	198	199*	200	201	202	203*	204	205	206	207	208	209	210
211	212	213	214	215	216	217	218*	219	220	221	222	223	224	225

* There are charges for items Nos. 5, 12, 22, 37, 51, 55, 90, 92, 136, 169, 185, 199, 203 and 218. See Notes below these items.

To receive Literature—Firm Name and your Position must be given.

Name..... ☐Am. Soc. C.E. Member
(Please Print) ☐ Non-Member

Position.....

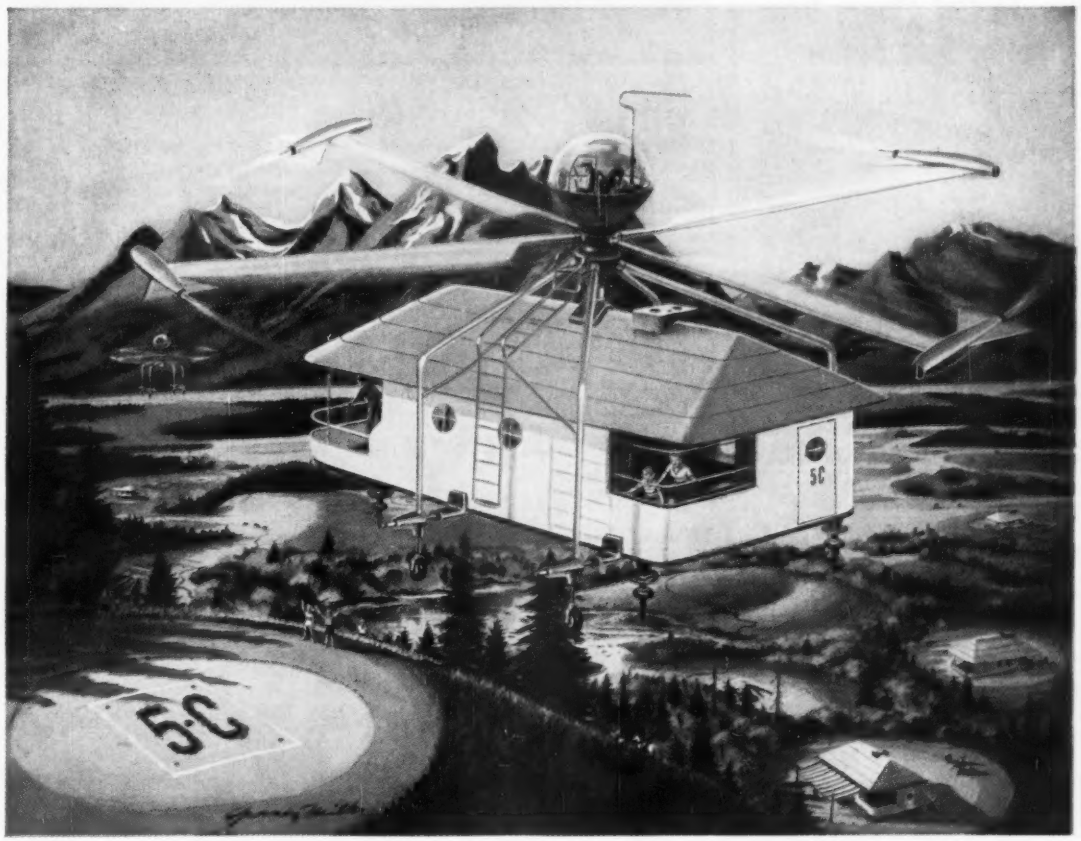
Firm Name.....

Firm Address—Street.....

City and State.....

NOT GOOD AFTER November 15, 1956, for readers in the U.S., but requests will be accepted to December 31, 1956, from readers outside of this country.

Use This Free Service—Mail The Coupon To-day



Giant helicopters . . . atomic-powered and capable of lifting vast tonnages . . . some day may transport homes intact from winter to summer locations . . . enable people to move with a minimum of disorder and effort.

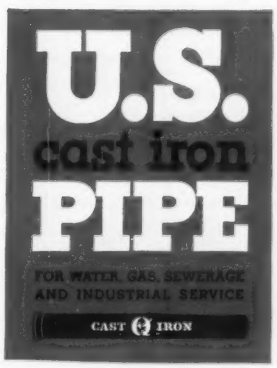
100 years from now...

WE MAY MOVE HOUSES BY AIR!

Many incredible changes in the world of tomorrow. But even then, our water and gas will still be carried by that dependable public servant—the cast iron pipe being laid today.

Records show that cast iron mains installed over a hundred years ago are still serving effectively for more than seventy American water and gas utilities. Moreover, the modernized cast iron pipe of today . . . centrifugally cast and quality controlled . . . is even stronger, tougher, more serviceable.

U.S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.



U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.

CATALOG DIGESTS

14 ASPHALT PLANT

Madsen Works—Catalog No. 800 shows complete specifications, description and illustrations of the Model 481 Asphalt Plant. This plant is available in capacities of 4000-lbs., 5000-lbs. and 6000-lbs. capacities. Plant features exclusive bin design, improved drive arrangement, and air operation of bin gates, asphalt pressure injection and mixer gate.

15 ASPHALT PLANT

Madsen Works—Catalog No. 20-S illustrates and describes the 2000-lb. SPECIAL Asphalt Plant. The plant is rated at 60 tons per hour, yet consistently produces in excess of 80 tons per hour. It is a portable plant, ideal for the not-too-large contractor, the municipality, and the large asphalt producer who has in mind a small permanent operation for producing about 480 tons per day.

16 AUGER DRILLS

The Salem Tool Company—Earth and rock boring auger drills are described in Bulletin M-105. Features of horizontal blast hole drills are explained, as are the following features of truck-mounted and self-propelled drills: power unit, transmission, main drive case, carriage, main frame, hydraulic unit and elevating jacks.

17 AUTOMATIC COUPLERS

Mayo Tunnel & Mine Equipment—A simple and economical automatic coupler for small mine cars is described in a recent brochure. In addition, side-dump cars, rocker-dump cars, car passers, pneumatic grouters, and muck bins are explained and illustrated.

18 AUTOMATIC LEVELING

Filotecnica Salmoiraghi, Inc.—A comprehensive booklet describes a new automatic level model 5172, designed on the suspension-lens principle, by which leveling is attained automatically and maintained indefinitely even if the instrument is inclined. Its use, maintenance and applications in surveying and construction work are fully explained. Catalog and descriptive literature are also available on the F/S repeating theodolite, optical planimeter with built-in tracing point and return-to-zero lever, and a full range of conventional leveling instruments.

19 BELT CONVEYORS

Link-Belt Company—Pre-Bilt sectional belt conveyors in standardized, pre-engineered units with capacities ranging up to 1,500 tons per hour are described in a new book. These conveyors incorporate standard Link-Belt components, including the new Series 50 idlers, packaged with sectional truss frames and structural steel supporting bents. They are built in 18, 24, 30, and 36-in. belt widths, with 24 and 42-in. deep trusses. Drives range up to 50 hp. More information is contained in the illustrated 8-page book 2579.

20 BELT CONVEYORS

Transall, Inc.—Bulletin 915 offers a brief description of prelubricated belt conveyor idlers, their advantages and dimensions available.

21 BITUMINOUS BATCH MIXING PLANTS

Barber-Greene Company—A bulletin of 12-pages describes and illustrates the revolutionary principles of Barber-Greene's 2000-4000 and 6000 lb "BatchOmatic" bituminous batch mixing plants. Plants feature fully automatic operation, simultaneous measuring of all aggregate and bitumen. "Dynamix" pugmill and many others are all diagrammed and illustrated with text and pictures.

22 BITUMINOUS CONSTRUCTION HANDBOOK

Barber-Greene Company—A "standard work" on bituminous road and airport construction, this second edition, has 285-pages, profusely illustrated with charts, photographs, drawings, tables, etc. Also issued as Technical Manual by U. S. Army and Air Force Engineers. Price $2.00.

N. B. There is a charge for this book. Make checks payable to Barber-Greene Company.

23 BITUMINOUS PAVER

Barber-Greene Company—In four colors, this 16-page catalog describes the famous Barber-Greene bituminous paver in detail. This description includes a 2-page, four-color spread showing the entire machine in cutaway. The operating principles of the unit are also graphically detailed.

24 BOILER AND STOKERS

The James Leffel & Company—Complete descriptive and specification information on rugged Scotch boilers for gas, oil and coal firing and automatic underfeed stokers for Scotch type boilers is given in a 28-page bulletin 236. This richly illustrated brochure includes test results, performance data, and complete details of design and construction.

25 BORINGS

Raymond Concrete Pile Co.—A booklet "Subsoil Investigations for Foundations" Catalog B-6 explains the reason for subsoil investigations, what Gow borings are and how they are made, and the results obtained. Illustrated are methods for making borings and taking samples, and various types of rigs in operation.

26 BRIDGE FLOORING

American Bridge Division—This 32-page booklet contains complete engineering drawings and design data for all available I-Beam-Lok sizes, plus detailed coverage of Specifications, including the type of steel, erection, fabrication, painting, field assembly and welding. A brief discussion of composite T-beam action between I-Beam-Lok flooring and steel stringers is also included.

27 BRIDGE FLOORING

United Steel Fabricators Inc.—Steps in bridge floor replacement with USF Structural Plate bridge flooring are discussed in an 11-page booklet. Specifications and engineering details are included.

28 BRUSH CUTTER

Dorsey Trailers—The Dorsey Brush Cutter is built tough for rough jobs. Advanced design, its special construction and its many advantages are discussed and illustrated by photos in a colorful brochure now available.

29 BUILDING PAPER

American Sisalkraft Corp.—More than just paper, Sisalkraft is a tough, waterproof, scuff-proof, wind and dust-proof building material. A folder describing this product, illustrated with photos showing its varied uses is available.

30 BUTTERFLY VALVES

S. Morgan Smith Company—has published the first half of what will be the most complete catalog of butterfly valves for industry that has ever been compiled. A 60-page catalog, in loose-leaf form offers a section on basic engineering data which is complete enough to permit the user to accurately size the valves needed. A complete description of each valve, with specifications, layout drawings and dimensions of standard valves in each pressure rating, is given. It also contains sections on special metals and modifications available for extreme operating conditions.

Timely
McGRAW-HILL BOOKS

SURVEYING FOR CIVIL ENGINEERS

Manual of advanced surveying techniques covering special instruments, methods, and procedures necessary for large surveys. Shows how to pick the method and perform complex surveys at minimum cost. Material presented by types of surveys, with full description, theoretical demonstration, and practical example. **By Phillip Kissam, Prof. of Civil Engrg., Princeton Univ. 716 pp., 456 illus., $8.50.**

CONSTRUCTION PLANNING, EQUIPMENT, AND METHODS

This book shows how to plan and carry out construction jobs using the **best combination of field-tested methods and engineering fundamentals.** How to analyze the project, prepare all schedules, and choose and manage the best equipment and methods for any given job is covered in great detail. Worked-out illustrative examples make all explanations crystal clear. Shows you the factors to consider and the calculations to make that will result in best economy and performance under varying conditions. **By R. L. Peurifoy, Professor of Construction Engineering, A & M College of Texas. 533 pp., 385 illus., $8.50.**

CONTRACTS, SPECIFICATIONS, AND ENGINEERING RELATIONS

Sets forth the important legal relations with which the engineer or architect should become familiar when starting his professional career; the scope of engineering ethics; the general requirements of contracts and the preparation of engineering specifications. Special emphasis is given to the writing of technical reports and business letters. **By Daniel W. Mead. Third edition revised by Mead and Hunt, Consulting Engineers, and Joseph R. Akerman, Assoc. Professor in Mechanical Engineering, U. of Wisconsin. 427 pp., illus., $7.00.**

WATER SUPPLY ENGINEERING

Thorough treatment of public water supply, also including private and industrial supplies. Discusses all phases of the subject necessary to complete waterworks planning and design—financial and administrative principles, estimating usage, computing surface runoff and ground-water supplies, hydraulics of flow, materials and their use, pumping stations, etc. Includes extensive treatment of water purification. **By H. E. Babbitt, San. Eng., and J. J. Doland, Prof. of Hydraulic Eng., Univ. of Ill. 5th Ed. 675 pp., 257 illus., $8.50**

ELEMENTS OF HYDRAULIC ENGINEERING

Covers hydrologic and legal aspects common to almost all hydraulic projects, structures required, elements of engineering economy, and special problems encountered in water supply and sewerage, flood control, drainage, irrigation, hydroelectric power development, etc. **By R. K. Linsley, Jr., and J. B. Franzini, Stanford Univ. 580 pp., 350 illus., $9.00**

TRAFFIC ENGINEERING

Brings together general knowledge in this new field for all engaged in highway traffic planning, operation, and administration. Covers traffic characteristics like speed, volume, parking, accidents. Includes material on regulation of traffic and control devices and aids. **By T. M. Matson, W. S. Smith, F. W. Hurd, all of Bureau of Highway Traffic, Yale Univ. 640 pp., 265 illus., $12.50**

FUNDAMENTALS OF TRANSPORTATION ENGINEERING

A practical and time-saving source of design data, and planning and construction methods covering every major type of transportation engineering. Covers roads and pavements, airport engineering, railroad engineering, river and coastal engineering, pipeline transportation, and belt conveyors. Discusses specialized functions of each field separately, and gives careful attention to procedures common to many of them. **By Robert G. Hennes, Prof. of Civil Engrg., Univ. of Wash., and Martin I. Ekse, Assoc. Prof. of Civil Engrg., Univ. of Wash. 520 pp., 202 illus., $8.50**

How to spot legal problems
in construction contracts
BEFORE THEY COST YOU TIME AND MONEY!

An "ounce of prevention" in your construction contracts can often mean the difference between a job that shows a profit and one that's bogged down in legal troubles. With the help of this practical Library, forewarn yourself of those problems that can so easily turn a profitable construction project into a losing proposition. This Library helps you avoid costly lawsuits by showing you—**before you become involved**—the different types of legal troubles which are likely to occur in connection with construction work. An authority you can rely upon, it discusses the common problems involved in the performance of contracts—gives scores of specific contract situations—clarifies the circumstances out of which litigation grows—and clearly indicates how you can eliminate similar obstacles in your own contracts.

PRACTICAL LEGAL LIBRARY

for Architects, Contractors, and Engineers

By I. VERNON WERBIN

Member of the N. Y. Bar; Licensed Prof. Engineer

What are your legal rights when unforeseen changes affect your contract? How soon must you perform a contract when there's no stated time limit? When can you as contractor get extra compensation? How much can you collect if the owner is dissatisfied?

These are just a sample of the 181 important problems discussed in this Library by a noted engineer-attorney in language you can readily understand. All instances cited are actual cases. In each you learn *what* caused the trouble, *who* was at fault, and *what the courts did about it*—so that you may be guided accordingly.

3 volumes
1128 pages
$14.00

EASY TERMS

$4.50 in 10 days and $5.00 a month

SAVE $2.50

Bought separately books cost $17.00

"Not only shows how to deal with specific types of legal problems when they do occur, but also specifies how to prepare contracts that won't cause trouble."

EXCAVATING ENGINEER

The Library is not intended to be a substitute for legal advice from an experienced attorney. But if you find yourself involved in any matter covered here, you will have the signals you need to take money-saving, preventive steps IN TIME!

PROFESSIONAL ENGINEER'S EXAMINATION QUESTIONS AND ANSWERS

Over 500 questions and complete answers to help engineers pass state license examinations. Covers mechanical, electrical, civil, and chemical engineering, and includes engineering economics and land surveying. Latest questions—suitable for all states. Author has worked on New Jersey examination preparation for 19 years. By William S. LaLonde, Jr., 462 pp., 234 illus., $6.50.

10 DAYS' FREE TRIAL

FREE EXAMINATION COUPON

McGraw-Hill Book Co., Dept. CNG-10
327 W. 41st St., New York 36, N. Y.

Send me book(s) checked at right for 10 days' examination on approval. In 10 days I will remit for book(s) I keep, plus few cents for delivery, and return unwanted book(s) postpaid. (We pay for delivery if you remit with this coupon—same return privilege.)

Print Name .....

Address .....

City ..... Zone ..... State .....

Company .....

Position .....

For price and terms outside U.S., write McGraw-Hill Int'l, N.Y.C.

- ☐ **Kissam—Surveying fo Civil Engrs—$8.50**
- ☐ **Peurifoy—Const. Planning, etc.—$8.50**
- ☐ **Mead—Contracts, Specif., etc.—$7.00**
- ☐ **Lalonde—Prof. Engrs Exam., Q. & A.—$6.50**
- ☐ **Babbitt & Doland—Water Supply Engrg—$8.50**
- ☐ **Linsley & Franzini—Hydraulic Engrg—$9.00**
- ☐ **Matson, Smith & Hurd—Traffic Engrg—$12.50**
- ☐ **Hennes & Ekse—Transport Engrg —$8.50**
- ☐ **Practical Legal Library—$14.50, payable $4.50 in 10 days and $5.00 a month**

CNG-10

CATALOG DIGESTS

31 CAST IRON MAINS

Cast Iron Pipe Research Association—A third edition of an illustrated booklet deals with the service record of existing cast iron mains laid in the 17th, 18th and 19th centuries. A summary of service records of cast iron water mains in 25 cities, based on a study sponsored by three water works association, is also recorded.

32 CAST IRON PIPE

U. S. Pipe & Foundry Co.—An 8-page booklet on centrigfugally cast, Tyton Joint pipe for water or other liquids. The newly developed Tyton Joint is simple, sturdy, and tight. Illustrations show details of joint and method of assembly.

33 CENTRIFUGAL PUMPS

C. H. Wheeler Mfg. Co.—Wheeler-Economy double suction single-stage centrifugal pumps are described and illustrated in a new 8-page bulletin A-156. They are recommended for general service wherever liquids of low viscosity are to be moved. Case is split on horizontal center line and rotating parts can be removed for maintenance without disturbing piping. Cross section drawings and construction details for standard sizes up to 10-in. discharge are included.

34 CHEMICAL WEED CONTROL

Grasselli Chemical Div., E. I. du Pont de Nemours & Co.—How long-term chemical weed control is achieved by the use of Telvar weed killers is explained in a 4-page colored folder, A-995. How and when to use, and a number of localities where successfully used are shown in detail.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

35 CLAY PIPE WARM AIR HEATING DUCTS

Clay Sewer Pipe Association, Inc.—An authoritative manual for installing clay pipe warm air heating ducts for both perimeter loop and radial systems has been published. Titled "Clay Pipe Warm Air Heating Ducts," the manual, containing over 10 pages, is fully illustrated and includes complete information on design, construction and dimensions.

36 COAL RECOVERY DRILLS

The Salem Tool Company—Bulletin M-101, a four-page, two-color pamphlet describes coal recovery drills 16-in. to 42-in. in diameter for 6-in. augers. Photographed are a heavy-duty barrel-type drill head 42-in. in diameter with tungsten carbide 3-prong pilot adjustable core burster, reinforced double auger flighting, barrel equipped with bug dust clearance spirals; and a 36-in. heavy-duty nut and slack drill head for drilling rock and producing nut and slack coal.

37 COFFERDAMS

Spencer, White & Prentis, Inc.—"Cofferdams," by Lazarus White and Edmund Astley Prentis is a trusted source-book covering actual design and construction of cofferdams as well as the theoretical features. The price is $10.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

38 COIL-FILTER

Komline-Sanderson Engineering Corp.—Available bulletins on the Coilfilter, a modern vacuum filter, describe how this filter is designed for modern sludge dewatering requirements. Outstanding features of the filter are defined as non-clogging, permanent filter media, constant output and low operating cost.

CATALOG DIGESTS

39 CONCRETE ACCESSORIES

Superior Concrete Accessories, Inc.—Just off the press, a complete 60-page catalog No. 600, is profusely illustrated. Includes newest additions to line such as, heavy duty Screen Supports for use with vibrating equipment on bridges, etc. and Speed Strip, a metal chamfer strip for forming corners. Catalog has handy table giving concrete pressures and safe spacings of form lumber and ties. (Sent in USA and Canada only.)

40 CONCRETE ADMIXTURES FOR UNIFORMITY

Sika Chemical Corp.—An all temperature concrete specification shows how setting time, water cement ratio, and concrete quality may be kept uniform year round. Bruchures describing Plastiment retarding densifier, Sikacrete accelerating densifier, Sikacrete accelerating densifier and Sika AER are included.

41 CONCRETE CARRIER

Oshkosh Motor Truck Inc.—Model 50-50 is the newest model in a complete line of 4-wheel and 6-wheel drive trucks backed by over 39 years' experience in manufacturing 4-wheel drive trucks. This series, described in a complete catalog, is designed specifically for use by the ready-mix concrete industry.

42 CONCRETE FORMING EQUIPMENT

Symons Clamp & Mfg. Co.—A new 24-page general catalog has been prepared in three colors. It describes in detail concrete forming equipment, including the all wood panel, steel ply, high strength panels with steel cross members, H form, champ form, mag-ply panels and steel strut wide panels as well as the firm's line of hardware that includes wire ties. These products are illustrated by on-the-job photos showing actual uses of the forms. Detailed drawings and specifications are included.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

43 CONCRETE FORMING ON SEWAGE PLANTS

Universal Form Clamp Co.—A 4-page bulletin points out the advantages of the Uni-Form Panel System in forming circular walls and Y walls on sewage treatment plant jobs.

44 CONCRETE FORMING SYSTEM

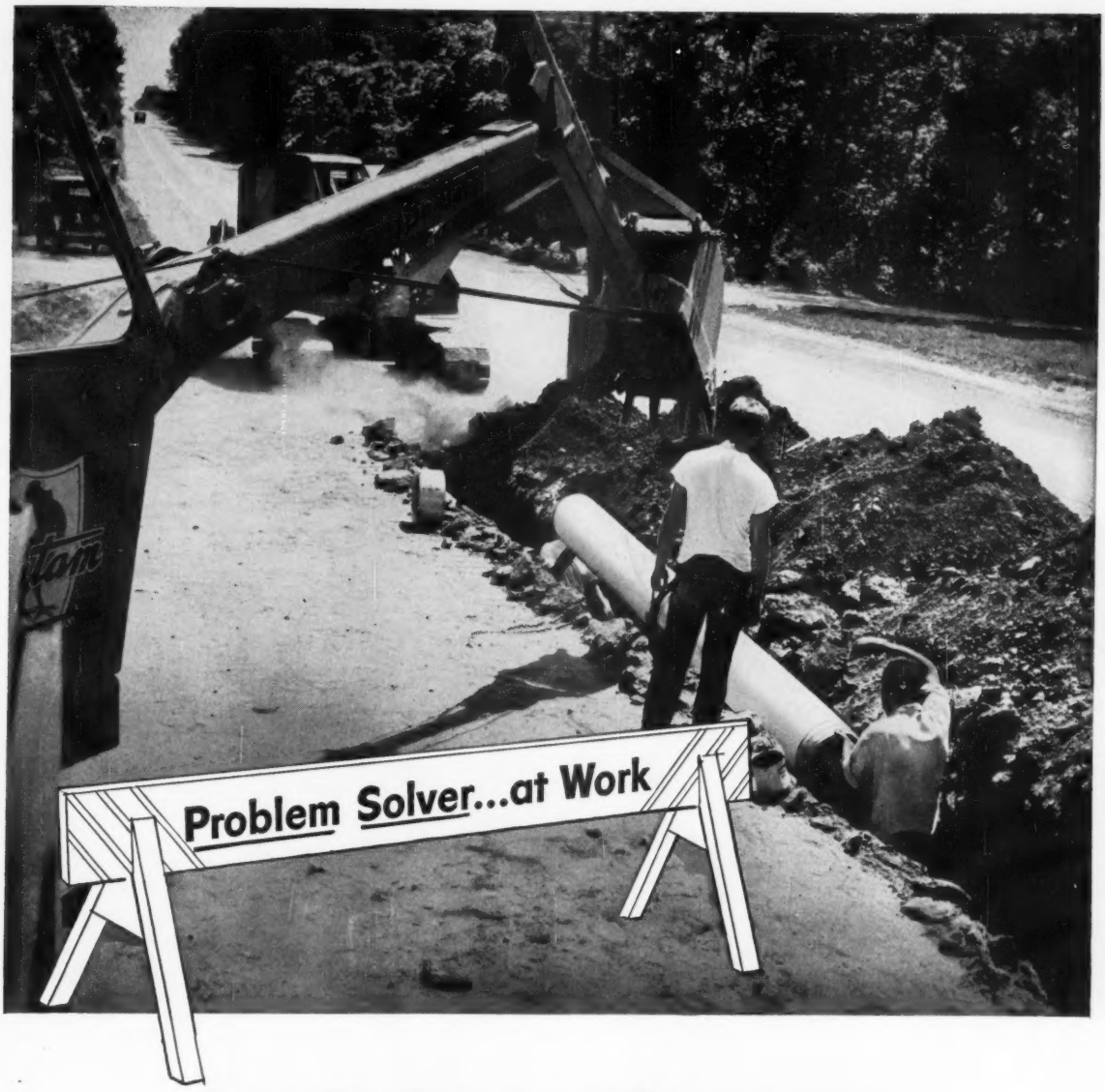
Economy Forms Corporation—A catalog with pictures is offered showing a complete forming system available to contractors on a purchase basis. The easy adaptability of these forms to all types of form work, plus engineering layout service on each new project, together with a complete steel form good for a lifetime of service makes the new EFCO form an attractive investment for the large and small builder.

45 CONCRETE FORMS

Universal Form Clamp Co.—A 32-page catalog points out to contractors the many features of Uni-Form Concrete Forms. It illustrates how forms are erected and stripped, gives a variety of applications and data explaining how Uni-Form Panels form concrete rapidly and economically.

46 CONCRETE FORM TIES, ACCESSORIES, ROAD BASKETS

Universal Form Clamp Co.—A 32-page catalog containing a complete line of form ties and concrete accessories. Catalog features form design table and formula for developing stud wale and tie spacings.



Transite Pressure Pipe assures dependable service through the years

ENGINEERS and city officials face much the same problem in pipe selection. It is twofold: (1) How to make sure the community gets many long years of trouble-free performance from its pressure mains, and (2) How to do this as economically as possible by choosing pipe for durability plus savings.

Transite® Pressure Pipe is solving this problem in hundreds of municipalities and water districts from coast to coast. Here's why. An asbestos-cement product, strong and durable and highly resistant to corrosion, it has effected economies in installation as well as operation.

For example, the community benefits even at the very outset, since both handling and assembly of Transite Pressure Pipe are so simple that crews can install as fast as trench is opened. This means lower installed costs.

Another Transite Pipe characteristic instantly recognized by engineers as of major importance is its smooth interior that stays smooth. This provides maintained high flow capacity. (Flow coefficient is C-140.)

* * *

For further information about Transite Pressure Pipe with the Ring-Tite® Coupling, write for Booklet TR-160A. Address Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

JM PRODUCT

Johns-Manville TRANSITE PRESSURE PIPE
WITH THE RING-TITE® COUPLING

CATALOG DIGESTS

47 CONCRETE FOR REACTOR SHIELDS

Intrusion-Prepakt, Inc.—New 12-page illustrated technical bulletin describes high-density Prepakt concrete for nuclear reactor shielding. The bulletin gives details on composition and placement methods using heavy aggregates, includes results of completed work using the Prepakt method, ten photographs and detailed diagrams. A list of other services, main and regional offices as well as foreign representatives are given.

48 CONCRETE HANDLING EQUIPMENT

Gar-Bro Mfg. Co.—A profusely illustrated 36-page catalog 300, containing specifications for more than 300 items of concrete handling equipment is now available. Serving as a job conditions and specifications guide, it features concrete buckets, chutes and hoppers, bucket attachments, powered crane hooks, carts, wheelbarrows, bins and batchers, paving vibrators, industrial wheels and other equipment.

49 CONCRETE MANUAL

Calcium Chloride Institute—Concrete users will be interested in a 40-page manual entitled "Calcium Chloride in Concrete." A ready reference to quantitative data, it includes nearly 20 charts and 40 illustrations which refer to the various aspects of calcium chloride as it is used in modern concrete construction. There is data on initial and final set, cold weather protection, air-entrained concrete, and integral curing.

There are 225 Digest items on pages numbered 122 to 150. Read all items for the literature of interest to you.

50 CONCRETE PAVEMENT MANUAL

Portland Cement Association—This new 72-page illustrated manual gives details of geometric pavement designs and outlines the best methods of construction. It presents in summarized, usable form, data on pavement layout and construction from recent technical society proceedings, engineering publications, field observations, tests and experience.
(Sent in U. S. and Canada only.)

51 CONCRETE PIPE FOR IRRIGATION AND DRAINAGE

American Concrete Pipe Association—An official publication is available to engineers. It contains information on design of irrigation pipelines, construction of irrigation pipe lines, methods of irrigating with concrete pipe lines and descriptions of various irrigation projects. This book is priced at 70¢.

N. B. There is a charge for this book. Make checks payable to the American Concrete Pipe Association.

52 CONCRETE REPAIR

Masonry Resurf. & Cons. Co., Inc.—"Iron Girdle Holds Concrete for Bridge Pier Repair" is a reprint illustrating the methods and techniques of "in the dry" repair of a 24-ft dia pier near Baltimore, Md. These procedures which revitalize deteriorated structures adding many years of useful life to an old structure are similar to those utilized in the "Dri-Por" system of pile repair. Many illustrations clearly show the work in various stages of repair.

53 CONCRETE SHORE PROTECTION

Portland Cement Association—Engineers and officials concerned with beach erosion control will be interested in a new, illustrated 30-page booklet on the use of concrete shore-protection structures. The booklet presents a discussion of wave action as well as other factors influencing the type and design.
(Sent in U.S. and Canada only.)

Thousands of Bethlehem High-Strength Bolts were used to join structural members in framework for new Prudential office building in Jacksonville, Fla. *Architects:* Kemp, Bunch and Jackson. *Contractor:* Daniel Construction Company of Alabama. *Fabricator and Erector:* Ingalls Iron Works Company.

High-Strength Bolting Speeded Erection of New Office Building in Jacksonville

This handsome building encased in marble, limestone and pink granite is the South-Central headquarters of The Prudential Insurance Company of America, at Jacksonville, Fla. The 22-story structure has a steel framework of 5,893 tons, held together with thousands of Bethlehem High-Strength Bolts. This method of construction saved erection time, as the bolting was completed within a week after the last piece of steel was set.

High-strength bolting is rapidly increasing in popularity as a means of erecting steelwork economically. Bolted joints are made rapidly. The bolts, used with hardened washers, can be installed in seconds. A holding wrench grasps the bolt-head, and the nut is driven to predetermined tension with a calibrated pneumatic impact wrench. That's all there is to it! There's no fire hazard involved. Besides, the bolting operation is less noisy than riveting, making it more suitable for use in hospital and school zones.

Bethlehem High-Strength Bolts are made of carbon steel, and come in sizes to meet virtually every construction need. They are heat-treated by quenching and tempering, and meet every requirement of ASTM Specification A-325.

You'll find the nearest Bethlehem sales office glad to assist in answering your questions about high-strength bolting. Why not give them a call right now? Or drop a line to us at Bethlehem, Pa.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

CATALOG DIGESTS

54 CONSIDERATIONS FOR CONCRETE AND MORTAR

The Master Builders Co.—A 4-page folder as a reminder of the important manufacturing considerations for concrete and mortar, to better adapt these materials to the specific needs they must fill under prevailing job conditions is offered. A helpful check-list in obtaining the desired properties in concrete and mortar—the only building materials manufactured on the job.

55 CONSTRUCTION SPECIFICATIONS

The Asphalt Institute—Construction Series 80, a 304-page manual contains a variety of asphalt construction specifications for: Priming, Surface Treatment, Road-Mix, Penetration Macadam, Base Courses, Cold-Laid Plant Mix, Hot-Laid Plant-Mix Surfaces and Block Pavement. Price $1.50.

N. B. There is a charge for this book. Make checks payable to The Asphalt Institute.

56 CORE DRILL MACHINE

Sprague & Henwood Inc.—A new Bulletin 30 completely describes and illustrates Model #30 Core Drill machine. Designed and manufactured by Sprague & Henwood it is being used by their Contract Drilling Department.

57 CORE DRILLS

Acker Drill Co., Inc.—Acker Bulletin 30 describes the Toredo core drill. The basic Toredo rig can be equipped with either a hydraulic or mechanical screw feed. Power plant can be either gasoline, diesel, air or electric motor. The unit is readily adaptable for mounting on drag skid, jeep, truck or trailer.

58 COST DATA

Barco Manufacturing Company—Of interest to earthmoving contractors is a bulletin of cost data for soil compaction in restricted areas. Specifications accompany the data.

Return the coupon on page 122

59 CRAWLER TRACTOR

Allis-Chalmers Manufacturing Company—The technical and operating story of the 45 drawbar hp HD-6 diesel-powered crawler tractor is told in a new catalog. In addition to specifications, the catalog lists the full line of matched equipment and accessories that have been engineered to the HD-6 which increases its versatility and economy, and provides maximum safety and comfort for the operator.

60 CURTAIN-WALL DATA

The William Bayley Co.—Aluminum-wall, curtain-wall and steel window wall systems are the subject of a new data reference file. Included are two brochures with specifications and detailed information as well as several folders of diagrams illustrating various window and curtain-wall systems.

61 DEPTH SOUNDER

Edo Corporation—A four-page brochure describes the Model 185 AN/UQN-1B, precision deep depth sounder, with a range from 0 to 6,000 fathoms, which was developed for the U. S. Navy and is now available commercially.

62 DESIGN HANDBOOK

Barkside Valves—A 64-page design handbook and catalog provides the means for proper selection of a pressure switch for every application. It contains a step by step selection chart, a complete rundown, illustration and tabulation of all the detail features leading to the unit that solves the control problem.

63 DESIGN OF CONCRETE AIRPORT PAVEMENT

Portland Cement Association—This 48-page booklet on the design of concrete pavement for airports presents design charts for determination of pavement thickness and concrete resurfacing. Also included are recommendations for jointing layout, the use of sub-base under concrete and the evaluation of existing pavements.
(Sent in U.S. and Canada only.)

64 DIRECT EXPANSION COOLING COILS

Halstead & Mitchell—A new line of direct expansion cooling coils, using "Turbu-Flo" finned surface for extra heat transfer, is explained in detail in a new 8-page catalog, DE-200. It describes coil construction, including tubing, casings, headers, refrigerant distribution, return bends and valves. 4-1/2-pages of tabular material enable easy selection of the proper coil by giving dimensional data, pressure losses, and pressure drop.

65 DRAFTING DESK

The General Fireproofing Co.—A colorful folder introducing the Draft-A-Matic, a drafting desk with built-in efficiency is available. Its many exclusive features are illustrated and explained in detail.

66 DRAFTING PENCILS

J. S. Staedtler, Inc.—A new booklet, entitled "Why is Everyone Interested in Mars?" has just been issued. It describes in detail every product in the company's line, including Mars-Lumochrom, the new colored drafting pencil that blueprints perfectly.

67 DRAIN GRATES

Irving Subway Grating Co., Inc.—A recently published four-page, two-color folder illustrating the use of open mesh steel flooring as drain grates is now available. The folder contains photographic illustrations and shows typical uses of drain grates. There are engineering drawings of the various types and complete technical data to facilitate estimates and specifications.

68 ENGINEERING FOR PRODUCTION

Grumman Aircraft Engineering Corp.—An engineering recruiting booklet for one of the chief suppliers of Naval aircraft, this publication gives a well-rounded picture of engineering opportunities at this corporation. It is addressed to engineers whose creative thinking ranges far beyond today's aircraft in anticipation of the tremendous developments in powered flight, developments which imaginative Grumman engineers will produce.

69 ENGINEERING OPPORTUNITIES

Northrop Aircraft, Inc.—An informative, new booklet is offered to all interested engineers. It depicts engineering opportunities in a variety of challenging Northrop projects such as the Snark intercontinental guided missile, supersonic jet trainer, and jet interceptor. The excellent benefits and working conditions offered in Northrop's soon to be completed multi-million dollar engineering science center, and the advantages of Southern California living for engineers and their families are vividly explained in this free booklet.

70 ENGINEERING TEXTBOOKS AND REFERENCES

The Ronald Press Company—Described in a special brochure is a selected list of current technical books of special interest to the engineer. These authoritative and up-to-date references and textbooks cover many important aspects of structural analysis, design, engineering economy and management.

CATALOG DIGESTS

71 EQUIPMENT FOR PLACING AND FINISHING CONCRETE

Creative Metals Corp. — A sales manual offers comprehensive listings of this company's "Better Equipment for placing and finishing concrete" in the form of a loose leaf booklet, each section complete in detail with price lists. Floats, tampers, vibratory screeds, carts and hoppers are discussed.

72 FIBRE FORMS

Sonoco Products Company—Sonotube fibre forms, as explained in a recent brochure, were developed to provide an economical method of forming round columns of concrete, also for pile encasement, both steel and wood. Particularly adaptable in the formation of piers for overpasses and bridges. The brochure contains photos of actual job applications. Technical data is also available.

73 FLOOR ARMOR

Irving Subway Grating Co., Inc.—Just published is a new catalog on Gridsteel floor armor. Gridsteel is made of steel bars on edge, bent and joined together in a continuous hexagonal mesh pattern. Floors armored with Gridsteel last indefinitely. Gridsteel prevents ruts or potholes from forming, gives an even tractional floor surface at all times. Catalog illustrates uses, advantages, and shows how quickly and simply Gridsteel is installed.

74 FLOOR GRATINGS

Borden Metal Products Co.—A catalog containing technical information on how to select, design, purchase and install floor gratings, safety steps, and floor armour, available in steel, aluminum or stainless alloys, is offered. Safeload tables, step-by-step procedure for ordering, planning and checking is included.

75 FLOOR GRATING AND STAIR TREADS

Kerrigan Iron Works, Inc.—A 16-page catalog gives a picture story of Weldforged grating and stair treads with continuous spiral cross bars alternating right and left, and slightly above bearing bars for extra safety. Electronically Weldforged into solid, one-piece units for strength and durability. Contains safe load table, engineering data on both grating and treads.

76 FORMING EQUIPMENT

Symons Clamp & Mfg. Co.—A new 8-page catalog has been released describing in detail, advantages of Symons' lightweight plywood forms, magnesium forms, and wood rim forms as well as form hardware, shore, ties, and column clamps. Completely illustrated, the catalog shows on-the-site applications of equipment along with cutaway drawings and photographs of corners, pilasters, fillers, walers, curves, and bracing and scaffolding. Also shown are such supplementary equipment as bar ties, tie chairs, washer ties and erection hardware.

77 FOUNDATION PILES AND CAISSONS

Franki Foundation Co.—A well illustrated and informative 12-page brochure describes in detail the Franki method of installing Displacement Caissons and Pressure Injected Footings. Caisson load test results on representative projects and reinforced concrete cap design data are noted. Various types of pile foundations installed by Franki are indicated.

78 FOUNDATION PIPE

L. B. Foster Co.—Important features of Taylor foundation pipe are discussed in Bulletin 542. On-the-job photos illustrate installations and piling used. Charts of sizes and typical pile driving logs are included.

CATALOG DIGESTS

79 GEARS

The Earle Gear and Machinery Company—A twenty-page catalog describes in general, the kinds and sizes of gears manufactured by this company. Its contents deal with spur gears, bevel gears, helical gears, worm gears, racks, non-metallic gears, sheaves, sprockets, special machinery of which gears form a part, and special gear information. Illustrated with photographs, it also shows actual Earle installations.

80 GLOBE VALVES

The Lunkenheimer Co.—A new, 4-page, three color detailed circular 602-2 on the two pressure classes of LQ600 Bronze Globe Valves, for a wide variety of services from normal to exceptionally severe, is now being offered. This circular describes and lists all the features of each LQ600 pressure class, and describes and includes the ASTM, ASME, and military specification numbers of the exclusively developed Lunkenheimer Brinalloy alloy used for the bodies and bonnets.

81 GRATING AND STAIR TREADS

Klemp Metal Grating Corporation—An illustrated report on the usage of steel, aluminum and stainless grating and stair treads includes a detailed safeload table with conversion factors, panel width constant chart and data on the standard widths and types of steel stair treads most frequently used. The brochure also discusses the various types of electro-forged welded grating as well as offering dimensional sketches and data on riveted grating.

In filling out the coupon, please print clearly and be sure that you furnish a complete address.

82 GRATING FLOORING AND TREADS

Irving Subway Grating Co., Inc.—General Grating Catalog F400 contains illustrations, descriptions and complete engineering data on grating flooring, treads and floor armoring (riveted, press-locked, welded types). Irving Grating is safe, durable, fireproof, ventilating, clean and economical for industrial and power plants and refinery walkways, stairways, driveways, trucking aisles.

83 GRAVITY FILTERS

The Permutit Company—Bulletin 2539B describes in its 24-pages the complete line of gravity filters and filter accessories: manually operated, semi-automatic, including operating tables, rate of flow controllers and gauges. Specifications, operating instructions, outline dimensions and typical installation photographs have been included in this edition.

84 GROOVED END VALVES

The Lunkenheimer Co.—A 4-page, illustrated circular 503, describes grooved end valves for use with grooved couplings. Designed for use with all types of standard grooved couplings, the extremely close tolerances of the valves assure a perfect fit of the coupling over the grooved end of the valve body and are particularly useful where pipe must be laid in the ground, over uneven terrain, in either temporary or permanent installations. The circular illustrates and lists prices and dimensions.

85 GUARD RAIL

United Steel Fabricators, Inc.—A 6-page brochure illustrates the typical uses of the USF Barrier Beam Guard rail. Installation, erection and specifications are discussed.

86 GUNITE

Pressure Concrete Company—Has a 48-page illustrated, free booklet on Gunite in all of its phases. The booklet contains specifications, job stories and illustrations showing Gunite repair of reservoirs, dams, filter plants, sewage disposal plants, stadiums, bridges, stacks and bunkers. The booklet also contains photographs on new prestressed tank construction and other data. A new leaflet just published illustrates pressure grouting to dams.

87 HEAD PULLEYS

Yuba Mfg. Co.—A new, 4-page folder, describing and picturing Yuba-Schrock internal drive head pulleys, has just been released. It explains the advantages of "the head pulley with the motor inside," pictures the pulley in use by contractors, a steamship line, batch plant manufacturer, and aggregate producers; contains an easy to read chart of sizes, dimensions and operating speeds.

88 HORIZONTAL FORM SUPPORTS

Universal Builders Supply Company, Inc.—The newest of all-metal adjustable supports used in suspended formwork is explained in literature now available. Called the S-L Spanall, it cuts the cost of concrete floor forms up to 40% and has a safety factor of 2.17. The ease of erection of these supports and detailed data are contained in the literature.

89 HOT-DIP GALVANIZING

American Hot-Dip Galvanizers Assoc., Inc.—A colorful booklet describes the Hot-Dip galvanizing method. The products shown in detail are a few examples used to illustrate the wide scope of the uses of this method.

90 HOW TO CORE DRILL

Acker Drill Co., Inc.—"Basic Procedures of Diamond and Shot Core Drilling" shows with over 80 illustrations and drawings the fundamentals of core drilling practice. Pipe driving, core recovery, core logging and storage are all covered in this pocket size book for the beginning driller. The price is $1.00.

N. B. There is a charge for this book. Make checks payable to Acker Drill Co., Inc.

91 HYDRAULIC CRANE

Austin-Western Works—An eight-page catalog, AD-2253, pictures and describes the new Austin-Western hydraulic crane. This tractor-mounted crane, with its pickup, carrying, and placement capabilities combines the best features of crawler, truck, and erection cranes with those of industrial shop cranes. All movements are actuated by fast, smooth, hydraulic control.

Return the coupon today!

92 HYDRAULIC DATA BOOK

Leupold & Stevens Instruments, Inc.—Interpretative data on water measurement and control is at your fingertips in this 144-page revised edition, in three parts: float wells and instrument shelters; errors in float operated devices; hydraulic tables; plus pages for notes and memorandums. Indispensable for the engineer with its wealth of information, tables and illustrations, the price of the book is $1.00.

N. B. There is a charge for this book. Make checks payable to Leupold & Stevens Instruments, Inc.

93 HYDRAULIC TURBINES

The James Leffel & Co.—Details on the Leffel turbine installation at the Philpott Dam Power Project are given in Bulletin 1095. Other current literature on varied and interesting hydraulic power developments include Bulletin 1086, TVA's Wilbur Dam"; Bulletin 1098, "Chandler Power and Pumping Plant"; Bulletin 1091, "Chatuge Dam Power Project"; and Bulletin 1094, "Nottley Dam Power Project.

94 INCREASING CRANE CAPACITY

Sauerman Bros., Inc.—Field Report No. 228 tells how to extend the reach of your crane and in many cases double its capacity with a Crescent scraper. A layout drawing illustrates the Sauerman method, and three pages of on-the-job photos support this promise of increased range and greater payloads. The report describes the advantages of scraper operation on certain jobs and offers an engineering service that will determine the largest size Crescent your machine can handle.

95 INDUSTRIAL PRODUCTS CATALOG

Johns-Manville—Has issued a 52-page catalog which offers essential data on the following groups of products: Insulations, refractory products, asbestos cement pipe, packings, gaskets, electrical products, frictional materials, roofing, siding, flooring, partitions, and ceilings. Photographs, diagrams, and tests have been revised and brought up-to-date so that engineers and plant executives will have the latest information in a compact catalog that is easy to use.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

96 INDUSTRIAL TRACTORS

Massey-Harris-Ferguson, Inc.—Here's a new concept of increasing machine efficiency. A colorful 23-page booklet explains and illustrates in detail, the great family of five versatile, economical industrial tractors, the MHF Work Bulls. On-the-job photos give a clear picture of these models with their integrated front and rear attachments for an exceptionally wide range of applications.

97 JETTING PUMPS

Griffin Wellpoint Corporation—A booklet illustrates jetting pumps for pile and caisson jetting, oil pipe line testing, water supply and fire protection. The illustrations show unusual setups for high-pressure jetting, including parallel and series pumping arrangements.

98 JOBS DESCRIBED

Boeing Airplane Company—An extensive brochure is offered describing the roles of aeronautical, civil, electrical and mechanical engineers, mathematicians and physicists in the design, research and production of advanced commercial and military aircraft and guided missiles at this company. Home address requested.

99 JOINT SEALING AND CAULKING COMPOUND

Servicised Products Corp.—Vertiseal is a newly developed rubber-type cold applied self-vulcanizing joint sealing and caulking compound which can be applied to both exposed vertical and horizontal joints, available in black and white. It has excellent adhesive qualities and will bond to concrete, metal, and glass. Literature available.

CATALOG DIGESTS

100 JOINT SEALER AND WATERSTOP

Sika Chemical Corp.—A brochure describes the four new consistencies of Igas Joint Sealer. The stiffer consistencies are used for water reservoirs, swimming pools, tunnels and deep basements. Lighter consistencies are used where there is no actual water pressure such as joints in metal building panels. Specifications and architectural details are included.

101 JOINTS FOR CLAY PIPE

Clay Sewer Pipe Association, Inc.—A 4-page circular describing five proven methods for jointing clay pipe has been published. "Joints for Vitrified Clay Pipe" as this new circular is called, is completely illustrated and gives detailed instructions for applying Hot-Poured Bituminous Joints, Wedge-Lock Joints, Pre-Cast Bituminous Joints, Mortar Joints and Pressure Joints.

102 K-45 KOMPACTOR

Buffalo-Springfield Roller Company—An illustrated 8-page colored booklet giving complete specifications and on-the-job performance reports of the K-45 Kompactor. The time saving, cost cutting Kompactor is self-propelled, highly maneuverable. Works on steep banks and all but eliminates hand-tamping. Features exclusive compaction principle.

103 LAYING CONCRETE PRESSURE PIPE

Price Brothers Company—A pocket-size book of instructions for laying concrete pressure pipe via the backhoe method contains up-to-date instructions (with photos and drawings) of proper trenching, checking grade, handling pipe, and completing the flexible watertight rubber and steel joint. Also shows a check list of equipment and supplies needed for the job.

104 LIGHTWEIGHT STEEL SHEET PILING

L. B. Foster Co.—Specifications and uses of lightweight steel sheet piling for protection of light-load excavations are explained in a new 4-page, 2-color, photo-illustrated bulletin now available. It shows how the piling, which can be rented or bought from Foster, is reused repeatedly for shore protection, sump pits, pier protection, sewer trenches, core walls, abutement, etc. Included also, are the exclusive Foster box-type corrugation design and interlock design, driving heads for use with standard airhammers and pulling tongs.

105 LONGSPAN JOISTS

Haven-Busch Company—The 1956 version of this 32-page catalog has just been completed describing the new series longspan joists SJI-AISC. It includes top chord extensions, graphs, maximum moment table, load carrying tables, panel dimensions, and other pertinent design data.

In filling out the coupon, please print clearly and be sure that you furnish a complete address.

106 LONG-SPAN Q-DECK

H. H. Robertson Company—Full information on exceptionally long-span deck describes ease of handling and erecting for lengths up to 32 feet. Designed especially for schools, supermarkets and other structures where long, unbroken spans and structural steel savings are beneficial it contains structural details, load tables and specifications.

107 MAPPING PRODUCTS

Fairchild Aerial Surveys, Inc.—A quick reference guide to Fairchild mapping products shows the materials and methods for producing different types of maps. Included are oblique and vertical photos, photo index and line index, controlled mosaic or photomap, topographic contour map, magnetic contour map, and radioactivity contour maps and strip chart.

108 MECHANICAL JOINT PIPE

American Cast Iron Pipe Company—Illustrated brochure containing installation photographs, instructions for assembly, weight and dimension tables, covering American Double-X mechanical joint pipe is offered.

109 METAL FURNITURE

The General Fireproofing Co.—A catalog, in color, illustrates aluminum chairs and tables, desks and files for the modern office and institutes. Also included are details on metal furniture of special design and steel shelving.

110 METERS, FEEDERS, AND CONTROLS

B-I-F Industries, Inc.—B-I-F 5 is a 12-page, two-color booklet which explains a varied line of equipment for metering, for chemical feeding and proportioning, and for controlling processes and operations.

CATALOG DIGESTS

111 METRIC WALL CHART

Mayo Tunnel and Mine Equipment—Simplified metric conversions, originally designed for the Mayo company office is now available. Newly revised chart includes: feet to meters; inches to meters; decimals of a foot; meters to feet plus other useful conversion factors. Illustrated are steel forms, tunnel shields, grouters and other equipment for the mining industry.

112 MINE, SHAFT AND INCLINE HOISTS

Superior-Lidgerwood-Mundy Corporation—The 16-page bulletin M515 describes and illustrates a full range of steam, electric, gasoline and diesel powered hoisting machinery which is "engineered and designed to suit," yet consists of standard parts. Also described are hoists for special purposes. Included are 36 illustrations of important installations; data required for estimating on mine, shaft and incline hoists; general information on mine hoists and hoists for shafts and slopes.

113 MOTOR GRADER

Caterpillar Tractor Co.—Understanding a motor grader and the operation of its control are the first step in becoming a proficient operator. Knowing how to apply these controls to get the desired results is the second step. Practice is the third. To help new motor grader operators and as review for experienced operators, "Basic Blading," a 32-page manual DE628 has been published. This manual is available in Spanish, French and Portuguese.

There are 225 Digest items on pages numbered 122 to 150. Read all items for the literature of interest to you.

114 MOTOR GRADER

The Galion Iron Works & Mfg. Co.—The Model T-600 Grade-O-Matic motor grader with torque convertor, tail-shaft governor and power shift transmission is photographed in color. Advantages and features, constructions, equipment and attachments are thoroughly discussed in Catalog 415.

115 MOTOR SCRAPER

Allis-Chalmers Manufacturing Company—Engineering, design, construction and mechanical features of the new TS-360 motor scraper that make it a big capacity earthmoving unit are outlined in a new two-color catalog. Photographs and drawings assist the reader to understand better the many advances incorporated in this 20-cu yd heaped or 15-cu yd struck capacity scraper powered by a 280-hp diesel engine.

116 MOTOR SWEEPER

Austin-Western Works—A 16-page catalog describes the motor sweeper. While designed primarily for use by municipal street and park departments, the Model 40 is also well adapted to use on airports, and in and about industrial plants of many types. Included in this catalog are brief specifications and photographs of the sweeper in operation on typical jobs.

117 MOVALLS

C & D Division, Yuba Mfg. Co.—A 4-page folder titled "Movalls or End-Dump Trucks?" has just been released. It compares end-dump trucks and positive-ejection Movalls on eleven different points and is liberally illustrated by on-the-job action photos.

118 NEW CONCRETING HANDBOOK

Richmond Screw Anchor Co., Inc.—A new handbook just issued gives a complete run-down of the latest in job-tested concrete form-tying and anchorage methods. It contains 46-pages of information, detailed working drawings, application data, safe load charts and spacing charts, etc. A useful guide in selecting the right method, tys and anchors for the particular job in any category; roads, bridges, tunnels, dams, water and sewage plants, building.

119 NEW DESIGN MANUAL

W. R. Meadows, Inc.—A new manual entitled "Design Techniques for Controlling Moisture in Building Structures" has been prepared by a firm of technical engineering writers. As this problem is of vital interest to all in the construction industry, this manual is now offered free to architects, engineers and builders. Please request on your letterhead.

Turn to page 122 and order your literature.

120 NEW PRECISION THEODOLITE

Kern Instruments Inc.—An illustrated pamphlet describes the new Kern DKM3 First-Order Theodolite designed by the internationally famous inventor, Dr. Heinrich Wild. Numerous revolutionary features which make the Kern DKM3 the most advanced first-order instrument, are described in the pamphlet.

121 NON-REPRO PENCIL

American Pencil Company—An interesting circular is offered describing the Venus Non-Repro Pencil. A rounded hexagon pencil with gold finish metal back cap and distinguished with a purple band, its translucent colored lead for non-reproducible images on translucent papers or masters is recommended when making duplicate copies by Dazio process such as Bruning, Ozalid or similar equipment.

122 NUTS AND RIB BOLTS

Automatic Nut Co., Inc.—A 4-page folder in color is offered for the attention and use of Architects, Bridge Engineers, Construction Engineers, Contractors, etc., explaining the economical use of rib bolts with Anco-Nuts. Load Chart, standard dimensions, weights and specifications are included.

123 OPTICAL TRANSIT

Geo-Optic Co., Inc.—An optical transit with erecting eyepiece, double center, T 50, represents a new low priced precision instrument enabling surveyors, engineers, etc., to cope with any possible problem of triangulation and to obtain results of the highest accuracy. A leaflet explaining this new type of theodolite is available.

124 PAVING HANDBOOK

American Bitumuls & Asphalt Co.—The latest edition of the Bitumuls Paving Handbook covers a wealth of practical data on paving methods and materials. These include road and airport paving specifications and construction details, complete tabular data on asphaltic binder applications and aggregate requirements, with condensed Asphalt Institute specifications. Also, there is data on Laykold compounded asphalts for flooring, tennis courts, and protective coatings.

125 PENCILS

Eagle Pencil Company—A 16-page booklet tells how to choose the right pencil for every job, and discusses general writing pencils, colored pencils and a number of specially designed pencils for special tasks. There is a special section of interest to the draftsmen.

126 PENCIL SAMPLE KIT

American Pencil Company—The Venus blueprint pencil sample kit is available. With specially formulated lead, the pencils give clear, non-smear markings on all blue or white prints and coarse papers. The Kit includes two new Venus blueprint pencils and a drawing pencil.

127 PHOTOGRAMMETRY

Jack Ammann Photogrammetric Engineers, Inc.—a new article entitled "Photogrammetry in Engineering and Allied Fields" explains how photogrammetry is used by City Engineers, Highway Engineers, and others. Shows examples of photographs and maps as well as including photographs of equipment used.

CATALOG DIGESTS

128 PILES

Raymond Concrete Pile Company—Standard and step-tapered piles are described in Catalog S-56 which also includes information on the scope of Raymond's activities covering every recognized type of pile foundation. Domestic operations include harbor and waterfront construction, and cement-mortar lining of pipelines in place. Raymond's services abroad also include all types of general construction.

129 PILES

The Union Metal Mfg. Co.—Catalog No. 81 on Monotube piles, in addition to general descriptive information, contains engineering data covering physical properties, specification suggestions and test loading; also, contractor data on concrete volumes and weights. It includes numerous photos showing a wide range of job applications throughout the country. Advantages listed: light weight, easy handling, economical field extendability, visual inspection after driving, highload carrying capacity with extra high economy per ton load supported.

130 PILE REPAIR

Masonry Resurfacing & Construction Co., Inc.—An eight-page illustrated pamphlet is offered describing the Dri-Por system of pile repair and encasement. The pamphlet describes the application of the Dri-Por system to the repair of the 5-mi James River Bridge system near Newport News, Va. Also included is a description of the Dri-Por K-box which allows repair of concrete piling in the dry, and high quality repair for wood and steel.

131 PIPE CLEANING EQUIPMENT

Miller Sewer Rod Co.—Free catalog lists information and prices on all types of electric and hand pipe cleaning equipment for cleaning out clogged-up toilets, wash basins, urinals, floor drains, sewers from 3 to 12-in., up to 500-ft in length. Units listed are said to remove roots, grease, rags, sand, glass and obstructions. Helpful advice states how you can save costly plumbing bills.

132 PIPE DETECTRON

The Detectron Co.—A bulletin describing the Detectron 505 which does an amazingly accurate job in determining the location and depths of hidden pipes, valves, services, etc., is offered. Exclusive features of this instrument are explained and illustrated.

133 PORTABLE GASOLINE RAMMER

Barco Manufacturing Company—Offers an eight-page catalog describing the Barco portable gasoline rammer for soil compaction. This tool is the only successful mechanical means of obtaining specified soil compaction in restricted areas such as in trenches and near walls and bridge abutments. It is easy to operate, safe, and will compact 20 to 30 cubic yards of fill per hour where high degree compaction is specified. Barco also offers a bulletin "Cost Data for Soil Compaction in Restricted Areas with the Barco Rammer" of interest to all earthmoving contractors.

134 POWER GRADERS

Austin-Western Works—A 20-page catalog, AD-2295, pictures and describes the complete new line of power graders with exclusive all-wheel drive and steer. All types of work are illustrated and discussed. Included also are brief specifications, a description of exclusive design features and detailed illustrations of the attachments.

CATALOG DIGESTS

135 PRECIPITATOR

The Permutit Company—Bulletin No. 2204C is a well-illustrated and documented 20-page pamphlet describing the many applications, principles of operation, design features, advantages, recommendations, flow diagrams and specifications of Permutit's precipitator. The precipitator offers, through its three basic designs, an efficient means of removing impurities from a liquid by precipitation, absorption, settling and filtration. Chief uses are in water softening, the reduction of alkalinity and the removal of turbidity, color, taste, odor, silica and fluoride.

136 PRECISION INSTRUMENTS

C. L. Berger & Sons, Inc.—"Solar Emphermeris and Polaris Tables," 1957 Edition, 96 pages, contains complete instructions for determining azimuths from the sun and the altitude of Polaris, has been prepared by Herman J. Shea, formerly Associate Professor of Surveying, Massachusetts Institute of Technology. Directions for making astronomical observations and computing results by direct solar observation and time from same observation: meridian by solar attachment; meridian by Polaris at elongation; azimuth by Polaris at any hour angle; latitude by sun at noon, and latitude by Polaris are included, as well as all requisite tables. Price is $.50 per copy.

N. B. There is a charge for this book. Make checks payable to C. L. Berger & Sons, Inc.

In filling out the coupon, please print clearly and be sure that you furnish a complete address.

137 PRECISION TRANSITS

Warren-Knight Co.—A new full page folder illustrating, describing, and explaining the 29 special features of the latest model, medium size, medium weight Precision Transits, Series 7 and 9, has just been issued. This new series Transits have many exclusive features which assure accuracy, ease, speed and convenience in handling, sturdiness, and a minimum of maintenance and repair cost. Price List is available without charge.

138 PREFABRICATED ASPHALT LININGS

Gulf Seal Corp.—Now in its second printing, a 24-page brochure details the experience of cities and industries in seepage-proofing a wide variety of projects using these linings. Specific projects reported on include several municipal drinking water reservoirs, industrial salt water storage pits, large irrigation canals for government, and industrial and municipal waterways of every type.

139 PREPARATOR AND ROTO-MIXER

Wm. Bros Boiler & Mfg. Co.—A two-color brochure announcing two new pieces of road construction, the preparator, in-place material reducer, and the roto-mixer, a blending and stabilizing unit for all types of materials, is available. The folder illustrates four ways the preparator will reduce road materials costs. The roto-mixer features independent control of rotor and hood to provide positive mixing depth control to any given depth up to the maximum depth of 24-in. To complete the team, the folder also illustrates the new self-propelled rubber tired tractor.

140 PRESSURE FILTERS

The Permutit Company—Bulletin 2225B describes Permutit's extensive line of pressure filters and their accessories. Specifications, operating characteristics, outline dimensions and typical installation photographs have been included in this edition.

CATALOG DIGESTS

141 PRICE LIST

Clipper Manufacturing Company—The current price list includes specifications of standard and super hp masonry saws, accessories, concrete saws, and abrasive, diamond and break-resistant polka-dot blades. Colorful folders are available describing the powerful new Model C-360, 36-hp concrete saw, and the 25 and 14.6-hp concrete saws. A hot-pour Model AC-40 joint sealer, and cold-applied Models CP-400 and CP-300 are described in circular 6004. Also listed are the 27 direct factory branches.

142 ROLLING DOORS

The Cookson Company—Bulletin 501 illustrating rolling doors, power or manually operated, offers general information on steel or aluminum service doors, counter doors and grilles. Specifications and optional features are included.

143 RUBBERIZED BITUMENS

Rubarite Inc.—A new highly efficient rubberizing material, Rubarite is produced specifically for use in asphalt and tar. A 16-page brochure is designed to present facts about Rubarite and rubberized bitumens which will be of interest to all who are concerned with surfacing materials as well as the asphalt engineer.

DID YOU MAKE YOUR CHECKS PAYABLE TO THE PROPER COMPANIES? ARE THE AMOUNTS CORRECT?

144 SCREENING EQUIPMENT

Link-Belt Company—The complete Link-Belt line for efficient removal of solids from water, sewage and industrial waste is described in the 28-page book, No. 2587. Dimension and specification data for four types of coarse screens and three types of fine screens, plus tables to determine the proper size unit handling various capacities, are given.

145 SEALING PRESSURE LEAKAGE

Sika Chemical Corporation—A brochure describes quick-setting compounds and methods for use in sealing pressure leakage, through concrete and masonry in tunnels, tanks and deep basements.

146 SELF-PROPELLED ROLLER

Wm. Bros Boiler & Mfg. Co.—A 2-color brochure describes the Bros self-propelled pneumatic tire roller, the SP-54, first all-rear-wheel drive roller with every pair of wheels oscillating. It illustrates the outstanding Bros design features especially engineered for smooth, fast, and economical operation on mat surfacing, seal coating and compaction jobs in the standard lift range.

147 SEISMIC SURVEYS OF THE SUBSURFACE

Geophysical Survey Division of Gahagan Dredging Corporation—A 13-page loose-leaf report with related technical article reprints, covers the seismic survey work done by the company for engineers in the planning and construction of highways, power plants and other buildings, dams, bridges, airfields, tunnels and water supplies.

CATALOG DIGESTS

148 SELF-REDUCING PLANE TABLE ALIDADE

Kern Instruments Inc.—A new brochure gives exact details about the new self-reducing plane table alidade. This completely new instrument eliminates use of slide rule, offset scale and dividers. Actual working experience shows time in field cut by 50%.

149 SEWAGE AND SLUDGE PUMP

Chicago Pump Co.—Bulletin 198 illustrates why SP-5 offers an unmatched performance record as a raw sewage and sludge pumps. Installations, specifications, parts and pumping characteristics are clearly detailed.

150 SEWAGE REGULATORS

Brown & Brown, Inc.—Bulletin 81-A describes sewage regulators designed to automatically control diverted sanitary flows from combined sewer systems, either by cutting off such flows entirely during storm periods, or by governing such diversions to a constant predetermined quantity regardless of storm conditions. Charts for the ready solution of diversion problems are included.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

151 SEWER CONSTRUCTION

Clay Sewer Pipe Association, Inc.—Detailed instructions for laying a sewer are contained in a new 4-page bulletin. Titled "Good Practice in Sewer Construction," this fully illustrated bulletin covers trench width, depth and bedding, as well as proper methods of finishing, back-filling and inspecting.

152 SEWER PIPE

Armco Drainage & Metal Products, Inc.—A 4-page illustrated bulletin describes a new type of pipe that provides top flow capacity with the strength of corrugated metal. Centrifugally-spun asphalt lining covers corrugations, thus assuring high flow during years of service. Flexible corrugated metal design gives strength under load. Strong joints insure a continuing integral structure. Asphalt lining endures heat and cold without melting, cracking or spalling; also meets stringent tests for adhesion and toughness.

153 SLUICE GATE

Rodney Hunt Machine Company—The first basic improvement in sluice gates in many years, the patented HY-Q flush bottom closure sluice gate, is described in Catalog 75. The newly released booklet, with 12-pages of illustrations, clearly shows all details of construction, installation, and operation of the unique gate as used in water filtration plants, power plants, municipal and industrial plants, drydocks, and flood control. Diagrams and text explain the many practical advantages offered by the HY-Q gate for water flow control. Complete recommendations for selection of frames and other equipment for sluice gates, as well as detailed specifications, series numbers, and clearance dimensions are also given.

CATALOG DIGESTS

154 SNOW MELTING AND ICE REMOVAL

American Iron and Steel Institute—An informative 31-page booklet explaining steel pipe snow melting and ice removal systems is offered. Prepared by the Committee on Steel Pipe Research, the uses of these systems, their design, installations, advantages and tables are clearly illustrated.

155 SOIL SAMPLING EQUIPMENT

Soiltest, Inc.—A new 128-page catalog contains over 1350 items of apparatus for engineering tests of soils concrete, asphalt and construction materials. Suggested laboratory layouts including complete mobile laboratories with equipment lists are shown. Items range from sampling and preparation equipment to testing machines for Triaxial, Unconfined Compression, Direct Shear, California Bearing Ratio, Consolidation and similar tests. A diversified line of scales, proving rings, dial indicators, ovens and thermometers is included.

156 SOIL SOLIDIFICATION

Chemical Soil Solidification Co.—A set of publications consisting of reprints of articles that have been published at various times, are offered. These publications, particularly the Journal of American Water Works Assoc., pamphlet, "Chemical Soil Solidification and Chemical Sealing of Concrete" by C. M. Riedel, gives a broad cross section of the work being done and the possibilities of solving serious tunneling, foundation-settling, problems in the varied construction fields and maintenance work, including the fight against beach erosion and strengthening of underground shelters.

157 SOIL SOLIDIFICATION

Manu-Mine Research & Development Co.—"The Science of Soil Solidification" is the title of a new 10-page bulletin. Contents include a detailed explanation of what soil solidification is, the methods employed, and solidified soil characteristics. In addition, one section of the brochure deals with the applications of the process to highways, mines, foundations, piers, dams and piling.

158 SPEED REDUCERS

The Earle Gear and Machinery Company—A sixteen-page illustrated catalog, describing speed reducers as applied to operating machinery, particularly bridge machinery, is available. Outlined are specifications service factors, horsepower ratings and dimensions of the particular units illustrated. Gasoline power units are also dealt with in a compact, easy-to-read form. Photographs are shown of actual installations with miniature blueprints included.

159 SPIRALWELD PIPE . . . COUPLINGS

Naylor Pipe Company—Bulletin No. 507 covers data on large diameter light-weight pipe for ventilating lines, air and water lines, irrigation pipe, etc. Sizes 4 to 30 inches in diameter includes standard fittings and welding flanges; also details on one-piece wedge-lock couplings.

160 STABILIZING GRAVEL SLAG STONE AND OTHER AGGREGATES

Seaman-Andwall Corporation—A 24-page bulletin, GSA-56, describing modern stabilization techniques of gravel, slag, stone and other aggregates. Designed and produced for engineers, highway officials, governmental bodies and students interested in low cost, simplified construction of secondary roads. Profusely illustrated with photographs, drawings and operational procedures.

CATALOG DIGESTS

161 STAINLESS STEEL GRATING

Kerrigan Iron Works, Inc.—A 4-page catalog on stainless steel floor grating-open steel, contains engineering data and safe load table. Weld-forged stainless steel grating is rust proof, chemical proof, non-magnetic and has a high heat resistance as well as high corrosion resistance. It is a boon to the chemical, oil and packing industries.

162 STANDARD PRODUCTS CATALOG

Link-Belt Company—A 340-page guide to one of the most complete standard lines of power transmission and conveying equipment is now available. This indexed book contains information for the engineer or layout man in selecting standard products for new installations or for replacements. It includes data on the line of chains for conveying and power transmission, ball and roller bearings, enclosed gear drives, clutches, gears, couplings.

163 STEEL FLOOR ARMOR

Klemp Metal Grating Corporation—An illustrated booklet describing the uses of steel floor armor to prolong the life of floors has been recently published. This new brochure shows both the application and installation of Hexteel heavy duty floor armor and Floorsteel flexible type floor armor through a number of simplified illustrations and engineering data. Included in this report are complete detailed specifications for both types of armor and instructions for determining the size armor which should be used for each specific installation.

Return the coupon today!

164 STEEL FOR HIGHWAYS

Bethlehem Steel Company—This 36-page illustrated booklet, "Steel for Highways," describes the broad range of Bethlehem steel products used in the construction of a modern highway. These include reinforcing bars, bar mats, dowel units, structural steel, wire rope, drill steel, pipe, guard rail and posts, fence and fence posts, sheet piling and H-piling, culvert sheets, rock anchor bolts, etc.

165 STEEL FORMS

Blaw-Knox Company—Bulletin 2430, illustrates and describes steel forms for concrete construction. Colorfully photographed in detail, the bulletin contains a number of the projects on which Blaw-Knox steel forms were used.

166 STEEL FORMS

Food Machinery and Chemical Corp.—A new bulletin 200 presents complete information on the Form-Crete system of all-steel prestressed concrete casting forms. The various forms available for casting pilings, lintels, single T joists, double T slabs, I Beams and bridge deck sections are described. Fully illustrated with product photos and scenes of pre-stressed concrete construction it shows clearly how it is now possible to cast prestressed concrete on a mass production basis.

167 STEEL GRATING AND TREADS

Blaw-Knox Company—A 15-page booklet 2486, illustrating the advantages of actual one-piece construction as presented by Electroforged steel grating is offered. Contains photographs of its many uses, types and spacing, fastening methods and a table of safe loads.

168 STEEL JOISTS

American Bridge Division—This 40-page catalog is the only steel joist catalog containing complete design information for spans up to 120-ft. Such subjects as design calculations, bridging, properties and dimensions, end details and accessories, load tables, marking systems for ordering, and specifications are clearly and completely covered in this catalog.

169 STEEL RIGID FRAMES MANUAL

Martin P. Korn—Part one presents the fundamentals of analysis and design, including selection of type of frame, derivation of basic equations, and tables of design for single span frames of from 50 to 150 ft. Part two of the volume is a collection of actual designs of a number of structures: an auditorium, bridges, and others. Martin P. Korn is the author. (J. W. Edwards, Inc., Ann Arbor, Mich., 1953. 170 pp., $4.50.)

N. B. There is a charge for this book. Make checks payable to J. W. Edwards, Inc.

170 STEEL UTILITY BUILDINGS

United Steel Fabricators Inc.—Adaptable to a thousand uses, the USF all purpose steel utility buildings are clearly illustrated in a 6-page brochure. Simplified erection, variable sizes and styles, portable or permanent and meeting all building codes, are some of the advantages discussed.

171 STRUCTURAL ARC WELDING

The Lincoln Electric Company—A continuing series of studies—how arc welding is used in modern structures—is issued periodically. Case histories of welded bridges, buildings and miscellaneous structures; drawings, details and calculations for typical structures are included. Current series is a study of school buildings.

172 SURVEY DEPTH RECORDER

Edo Corporation—A four-page brochure describes the Model 255 survey depth recorder, an extremely accurate echo sounder which measures depth of water in eight overlapping ranges, from 0 to 250-ft or fathoms.

173 SURVEYING INSTRUMENTS

C. L. Berger & Sons, Inc.—A 16-page condensed catalog, "Accuracy in Action," illustrates the engineering and surveying instruments manufactured by the company. General characteristics, optical systems and accessories for the Berger line of engineers' transits, levels, mining transits, theodolites, collimators and alidades are fully described with essential specifications for each. A section devoted to builders' and contractors' instruments is also included.

174 SURVEYING INSTRUMENTS

Charles Bruning Company, Inc.—Brunson engineering transits and levels, which incorporate patented dustproof ball-bearing construction, are described in a brochure now available. The brochure describes how use of the ball bearing principle prevents costly maintenance, eliminates looseness in bearings, and permits operation in temperatures ranging from 70-deg below zero to 160-deg above zero. It also illustrates various models of instruments.

175 SURVEYING INSTRUMENTS

Fennel Instrument Corp. of America—This firm has added a new One-Second Theodolite, with several special features, to their complete line of Levels, Transits and Theodolites for all purposes. A brochure and other literature are offered, containing photographs, detailed descriptions of the instruments and prices.

CATALOG DIGESTS

176 SURVEYING INSTRUMENTS

Kern Instruments, Inc.—A 32-page brochure offers a brief description of the most important instruments manufactured by Kern & Co., Ltd., of Aarau, Switzerland. Fully illustrated, it acts as an index to the detailed literature available on each instrument. Included in the brochure are theodolites, levels, self-reducing tachometers, alidades, pentagonal prisms and many other instruments.

177 SURVEY MARKERS

Copperweld Steel Company—This four-page leaflet introduces non-rusting survey markers which will locate survey points permanently. Each marker consists of a steel core to which a thick copper covering is molten-welded. A new adapter available for the bronze-head marker provides an extra-large surface for stamping identification. The leaflet provides specifications and explanatory photographs.

178 SWIMMING POOL EQUIPMENT

National Pool Equipment Co.—Technical service by their staff of specialists on pool problems involving advice on modernization and repairs, equipment renewals, chemicals, pool operation and maintenance is offered in Catalog 256. Complete equipment is available for new pools and repair of present facilities. This equipment is fully described in the booklet and in many instances detailed so that the designer may choose the equipment to serve the purpose intended.

In filling out the coupon, please print clearly and be sure that you furnish a complete address.

179 TAMPERS

Wm. Bros. Boiler & Mfg. Co.—Brochure RE-140 covers tampers in medium and giant weights. Single, double and triple drum models are listed. Standard sheepfoot tampers and standard diamondfoot tampers with relief shank are shown, also the Tamprite feet with replaceable Tamprite tips.

180 TAPES AND RULES

Lufkin Rule Company—A 290-page catalog No. 104 is offered giving a detailed listing of measuring tapes, rules and tape rules. A complete price list is included.

181 TECHNICAL DATA CATALOG

Lefax Publishers—A newly revised 1956 catalog of pocket size technical data books is announced. These handy pocket books cover every field of engineering. The books contain 140 loose leaf pages of up-to-date material, concise, comprehensive and authoritative. Partial listing includes surveying, tables, highway engineering, general math, trig-log tables, reinforced concrete and piping data.

182 TENNIS COURTS

American Bitumuls & Asphalt Co.—"Laykold Tennis Courts" is the title of a new 12-page, four color booklet containing detailed specifications and color photographs of typical installations. There are sections on cost, maintenance, resurfacing and player acceptance. These bituminous courts offer resilient, grit-free, all-weather type surfaces.

CATALOG DIGESTS

183 TEST BORINGS

The Giles Drilling Corp.—A 7-page booklet explains how test borings reveal soil conditions beneath the earth's surface—serve as your "eyes" below ground. It describes briefly the many boring methods in use today, considers the advantages and limitations of each, and discusses the importance of subsoil investigations in engineered construction.

184 THEODOLITE

Geo-Optic Company, Inc.—A leaflet describes the optical universal theodolite Askania Tu with a direct reading of one second and estimation $^1/_{10}$ second. The Askania Tu Transit enables surveyors to cope with any possible problem of triangulation and to obtain result of the highest accuracy. All readings are done from one position—an important time factor. Other advantages and data are included.

185 THICKNESS DESIGN

The Asphalt Institute—Manual Series No. 1, a 44-page easy-to-handle manual contains information for the determination of the design thickness of flexible pavement structures. Covered are: Traffic Analysis; Material Analysis; Alternate Designs; and Economic Analysis and Selection of Design. An Appendix A outlines compaction requirements and Appendix B contains four examples of how thickness designs are determined. Price $.20.

N. B. There is a charge for this book. Make checks payable to The Asphalt Institute.

RETURN THE COUPON TODAY FOR IMMEDIATE RESULTS!

186 "THIS IS BLAW-KNOX"

Blaw-Knox Company—A colorful 46-page bulletin gives a complete listing of the various divisions of this company and the many products they make for a wide variety of industries. Interesting illustrations of the broad scope of Blaw-Knox activities.

187 THREE-AXLE TANDEM ROLLER

Buffalo-Springfield Roller Company—The KX-25E tandem roller is featured in a new catalog. With exclusive walking-beam compaction control, the KX-25E is a heavy duty 3-axle tandem giving extra compaction where and when needed. Dimensions, specifications, weights, compressions chart and cut-away diagrams are included in the catalog.

188 THREE-AXLE TANDEM ROLLER

The Galion Iron Works & Mfg. Co.—This power multiplying drive unit is the culmination of several years of research, testing and proving. In addition to transmitting engine power, the Roll-O-Matic drive automatically multiplies the engine driving force by means of oil in motion instead of by transmission gears. A colorful Catalog 405 discusses mechanism, benefits, weights and specifications.

189 THREE-WHEEL ROLLERS

Buffalo-Springfield Roller Company — Three-wheel rollers with powered hydraulic roll brakes and tapered roller bearings on all rolls, an exclusive performance feature of these rollers, is described in a 10-page catalog. Made for heavy-duty, they are variable in weight; the two models range from 10–14 tons and 12–15 tons.

190 THREE WHEEL ROLLER

The Galion Iron Works & Mfg. Co.—Large diameter, extra heavy steel drum rolls which provide a variable weight three wheel roller with which you can get the service range of several non-ballast rollers is described in Catalog 410. Outstanding features including the Roll-O-Matic Drive are carefully detailed.

191 TIDE GATES

Brown & Brown, Inc.—Bulletins 69 through 76 describe various types of tidal gates, both circular and rectangular, and give authentic information regarding head losses.

192 TRACTOR SHOVEL

Allis Chalmers Mfg. Co.—Structural features of the HD-6G Diesel powered shovel are discussed, and the shovel hydraulic system of this tractor shovel reviewed, in a new two-color, 8-page catalog, MS-1101. Photographs, drawings and charts help convey the shovel's story of high output, long life, easy, time saving servicing and show the features built into the unit for operator comfort and safety. Also included are specifications and listing of interchangeable matched attachments designed and engineered to the HD-6G to increase its versatility and performance capabilities.

193 TRACTOR SHOVELS

Clark Equipment Co.—The all-wheel drive Michigan Model 175-A, with a 2-$^1/_4$ cu yd capacity that makes it the biggest rubber-tired tractor shovel available, and the smaller 1-$^3/_8$ cu yd Model 125-A, their design, construction and operation are completely described and fully illustrated in a new 12-page catalog, 1250-P.

194 TRANSIT

Wild Heerbrugg—A new piece of literature describes the reading principle of the new twenty second T-1 Repeating Transit. Model T-1 is now available as an alternative to the standard model (reading direct to one minute interpolations to six seconds) and gives direct reading to twenty seconds on both circles with easy interpolations to ten seconds.

195 TRANSITS

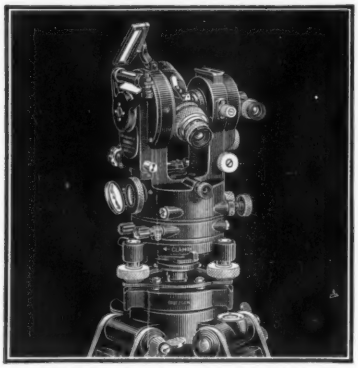
W. & L. E. Gurley—The complete line of surveying, and engineering instruments, including transits, levels, alidades are described in Catalog 50. The bulletin includes a cross-sectional drawing of the Gurley precise transit. Transits described include the hell gate precise transit; standard precise transit; the Gurley telescopic solar transit; the standard precise mining transit; and the optoplane precise transit for industrial use.

196 TREATING PLANT

Infilco, Inc.—Bulletin 1825 describes in detail with photographs the Accelerator treating plant units. Characteristics, advantages, design, operation, applications and specifications are carefully discussed.

197 TUNNEL & MINE EQUIPMENT

Mayo Tunnel & Mine Equipment—A newly published catalog comprehensively depicts all-steel forms and various types of tunnel haulage and mine shaft equipment. Detailed descriptions and pictures accompany the data.



CATALOG DIGESTS

198 TUNNEL CONCRETING

The Master Builders Co.—A 28-page illustrated booklet that contains case histories of the successful control of concrete quality achieved during the construction of 12 major tunnel projects in the western hemisphere. Discussion covers concreting problems encountered in the three basic types of tunnels (railroad, water and highway) and describes the role of Pozzolith, concrete admixture, in obtaining uniform, better quality concrete under widely varying job conditions.

199 TUNNELS

Spencer, White & Prentis, Inc.—"Famous Subways and Tunnels of the World," by Edward and Muriel White recounts the fascinating history of subways and tunnels from earliest times. The price is $2.75.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

200 TURBO-COMPRESSOR

The Spencer Turbine Co.—Clean air for agitation of liquids is the subject of Bulletin 142-B. This four page booklet describes in detail the Spencer Turbo, a self contained package unit, including turbo, motor, blast gate, check valve, etc. Specifications are included

In filling out the coupon, please print clearly and be sure that you furnish a complete address.

201 TURBO-DOZER

Clark Equipment Co.—More than 50 photographs arranged in film clip fashion illustrate the operation and correct application of the Michigan Model 180 Turbo-Dozer in a new 20-page booklet. A running commentary or "script" alongside the photographs describes the operational features of this first rubber-tired dozer powered by a turbocharged diesel engine.

202 TWO-AXLE TANDEM ROLLERS

Buffalo-Springfield Roller Company—A 12-page colored folder describes two-axle tandem rollers, which come in four different models ranging from 5 to 16-tons. With power roll brakes, superior vision design and bevel gear final drive, each feature of these rollers is fully explained in the catalog.

203 UNDERPINNING

Spencer, White & Prentis, Inc.—"Underpinning," a book by Edmund Astley Prentis and Lazarus White is recognized as the authoritative source for information in the field by engineers, architects and contractors all over the world. The price is $10.

N. B. There is a charge for this book. Make checks payable to Spencer, White & Prentis, Inc.

204 UNDERWATER TELEVISION CAMERAS, METAL LOCATORS, POWER DIVERS

Bludworth Marine—New literature is available describing Underwater TV Camera-diver holds camera-continuous picture to monitor screen on boat or land. Depths to 180 ft, Metal Locator UML 20, pinpoints ferrous and non-magnetic metals in fresh and salt water. "Power Diver" UPD 3, self propelled for depths to 200 ft. Also available new literature on Radar, improved Precision Dept Recorders for underwater survey, dredging, oil exploration, and Radio-telephones.

CATALOG DIGESTS

205 UPWARD-ACTING DOORS

The Kinnear Manufacturing Co.—The catalog and data book discusses fully and illustrates the advantages, the economy, the construction features and the general specifications of the various types of wood and steel upward-acting type doors. Known as Bulletin 88 it gives information on installation, clearance requirements, methods of operation and controls, as well as adaptability of the doors for many types of uses.

206 VALVES

The Lunkenheimer Co.—A 500-page catalog 53, describes a complete line of valves, lubricating devices, cocks and specialities. This illustrated catalog is indexed and bound, and contains engineering reference data and a guide for selecting valves, boiler mountings and lubricating devices.

207 VANE SHEAR TEST KIT

Acker Drill Co., Inc.—Acker Bulletin 700 describes a new vane shear test kit for obtaining in place soil shear strengths. Kit includes a complete set of attachments for making shear investigations to 100 ft depths in $2^1/_2$, 3 or 4-casing pipe.

208 VERTICAL DRILLS

The Salem Tool Company—A four-page, two-color brochure explains the new heavy-duty drill Model 106-24 which is a companion drill to the 106-8. The vertical drills meet the requirements of weight, ruggedness, ease of operation, and versatility, and may be used in highway and turnpike construction, seismograph work, strip mine operation and stabilizing hillsides and dams. A specifications chart is included.

209 VERTICAL TURBINE PUMPS

Layne & Bowler, Inc.—A 72-page hard-back book entitled "The Answers to Your Questions about Layne Vertical Turbine Pumps," is ideal for quick reference, complete with cut-away diagram illustrations, pictures and charts and written by one of the foremost authorities on vertical turbine pumps. Request on your own letterhead.

210 VERTICAL WATER WELL

Ranney Method Water Supplies, Inc.—The newest development in the vertical waterwell field is the subject of a new brochure. Called the Vertube, it is a natural gravel vertical water well, designed exclusively for low volume users, at low cost. A diagram of the well completes the brochure.

211 WARNING SIGNALS

Federal Sign and Signal Corp.—Warning signals that can save lives and protect your property are shown by Federal Sign and Signal Corporation in Catalog 300. Illustrated are sirens and warning lights for highway emergency, construction, and service vehicles.

212 WATERSTOPS

Water Seals, Inc.—A colorful eight-page brochure illustrating a complete line of waterstops along with the particular job application of each is available. Polyvinyl waterstops are flexible enough to withstand extreme joint separation, yet are rigid enough to stand up to the battering effect of pouring concrete. The stops are unaffected by acid, alkalies, petroleum products, chemicals or adverse atmospheric conditions and will not rust, rot, check or crack.

213 WATER, SEWAGE, AND WASTE

B-I-F Industries, Inc.—A 24-page, 2-color booklet, Bulletin B-I-F 6 offers a complete line of products for the treatment of water, sewage and waste. The products offered include meters and instruments, feeders processes equipment, controls, and filters and filter operating equipment.

214 WATER SUPPLIES

Ranney Method Water Supplies, Inc.—The Ranney collector, infiltration gallery, and new vertube well are fully described and diagrammed in a four-page folder. These various methods provide a water program for every community, industry and budget. A list of foreign representatives is included.

215 WATERSTOPS

W. R. Meadows Inc.—A new catalog 101 is offered covering Sealtight "Durajoint" the amazing new Polyvinylchloride-PVC Waterstop for expansion and construction joints. Specifically compounded and designed for use between adjacent sections of concrete structures, it is reported to have many qualities such as; resistant to extreme waterhead pressures, tensile strength of not less than 1900 lb per sq in., superior holding strength, elongation ability of more than 350%, lifetime expectancy of approximately 300 years, and is chemically inert, resistant to acids, alkalis, weather, oil, etc.

216 WATER TREATMENT

General Filter Co.—Bulletin 5131 offers a complete description of Contraflo. This combination of the basic functions of chemical mixing, coagulation and sedimentation in a single tank is one of the most significant developments in the art of water treatment. Written in detail and well illustrated, it contains much useful technical data.

217 WATER WORKS SUPPLIES

Smith-Blair Inc.—General Catalog No. 5, consists of a series of bulletins in loose-leaf form, complete with descriptions, sizes, specifications and price lists of the various clamps, couplings, lugs, flange adapters, etc., manufactured by Smith-Blair.

218 WELLPOINT DEWATERING

Griffin Wellpoint Corporation—"The Wellpoint System in Principle and Practice" is a handbook of the fundamentals of wellpoint dewatering and is applicable to any wellpoint system regardless of manufacture. This handbook contains information on how a wellpoint system functions, and methods of planning, layout, installation and removal of the system. The manual is pocket size, 109 pp in length and contains 62 diagrams and illustrations. The price is $1.50.

N. B. There is a charge for this book. Make checks payable to Griffin Wellpoint Corporation.

219 WELLPOINT DEWATERING SYSTEM

Griffin Wellpoint Corporation—A catalog describes the many items of Griffin wellpoint equipment together with pump capacity charts. It contains a series of actual job photographs showing this equipment on various types of construction projects.

220 WELLPOINT SYSTEM

Moretrench Corporation—An informative 76-page catalog, fully illustrated, describes the Moretrench wellpoint system and its use in dewatering various types of construction projects. It includes useful technical data on the system.

221 WELLPOINT UNWATERING SYSTEM

John W. Stang Corporation—A new 100-page revised edition of this catalog describes the component parts of the Stang wellpoint unwatering system; its planning, engineering and various methods of installation. Numerous recent projects have been added to demonstrate either a new application or some novel technical feature in the engineering and installation of the wellpoint equipment. Specific installations on dams, powerhouses, pipelines, tunnels, are illustrated from photographs made in the field. Heavy construction of all types in all varieties of soil conditions where ground water is encountered is described fully.

222 WIRE ROPE

American Steel & Wire Division—A 85-page catalog 6510 describes and illustrates in color, the most popular Tiger brand wire ropes. Grades, sizes, and specially designed ropes are listed together with directions for their handling and care.

223 WIRE ROPE FITTINGS

Sauerman Bros., Inc.—Bulletin No. 164 describes the Sauerman line of fittings. It contains blueprint drawings, tables and ordering information on open and double wedge sockets, pins and continuous cable clamps. The brochure also shows pictures of the fittings in various field work and tells of other applications.

224 WIRE ROPE SHEAVES

Sauerman Bros., Inc.—Bulletin 165, shows specifications for their Durolite sheaves carried in stock. A table gives detailed dimensions of sizes from 6 in. to 24 in. Durolite Sheaves are designed for use with wire rope running at high line speeds in horizontal planes under heavy loads. These sheaves are a basic part of Sauerman Durolite wire rope blocks and are now available as replacements in other blocks.

225 ZEOLITE WATER SOFTENERS

The Permutit Company—Bulletin 2386-B, describes troubles caused by the utilization of hard water and the multiple economies effected by curing them. This 20-page bulletin should be of interest to all engineers dealing with water problems. Equipment specifications, operating characteristics, data on Permutit ion exchange resins and typical installation photographs have been included in this new edition.

Turn to page 122 and order your literature.

PROCEEDINGS AVAILABLE

For instructions and Key to Abbreviations, see next page. Each member is entitled to 100 free "Proceedings Papers" yearly, ordered from these pages, plus all papers of the Technical Divisions in which he registers. The latter papers will be mailed automatically. To register, mail the enrollment form on page 153 to Society Headquarters. Discussion of a paper will be received during the four full months following the month of issue.

August

1047. Some Design Considerations for Oxidation Ponds, by E. F. Gloyna and E. R. Hermann. (SA) The demand for economical sewage disposal systems for small communities has prompted research into some of the design considerations for oxidation ponds with an eye to using the final effluent for irrigation. B. O. D. loadings up to 200 lb per acre per day are possible.

1048. Discussion of Proceedings Papers 687, 846, 885, 887. (SA) C. N. H. Fischerstrom on 687. P. R. Kriege on 846. J. S. Wiley and G. W. Pearce closure to 846. K. Kawata on 885. J. S. Wiley on 887.

1049. Engineering and Malaria Eradication, by P. N. Owens. (SA) This paper describes the steps leading up to the establishment of programs for the eradication of malaria by the countries and territories of the Americas. The responsibilities of engineers in these programs are outlined and a typical program is described. Special problems relating to the design of equipment are also discussed.

1050. Investigations of the Hydrology of Small Watersheds in Texas, by T. Twichell. (SA) With the increased importance of water, it is necessary that basic data be obtained to evaluate (1) the natural occurrence, quantity, and quality of water for a region through extended climatic cycles; (2) the interrelationships of surface and ground water; and (3) the effects of man's developments upon the water resources. The obtaining and evaluation of this basic data is given for small watersheds in Texas.

1051. Radioactive Sediments in the Tennessee River System, by J. M. Garner, Jr., and O. W. Kochtitzky. (SA) The increased use of radioactive materials poses a definite problem as to their ultimate fate. With nuclear power the engineer must be able to determine the fate of the radioactive wastes discharged into a receiving stream. The equipment and techniques for determining the concentration of radioactivity in river sediments are discussed for the area just below the Oak Ridge National Laboratory.

1052. Coagulation and Sedimentation, by J. M. DallaValle. (HY) By initially assuming a monodisperse system of particles or nuclei, the change of collisions leading to 1, 2, 3, etc., aggregated particles is computed according to the procedure used by Smoluchowski. The effect of settling is ignored by assuming the process to be very fast. The general law of settling of dilute suspensions as well as highly concentrated suspensions is discussed.

1053. The Role of Chemically Combined Oxygen in Biological Systems, by R. E. McKinney. (SA) Oxygen is the most important element in biological waste treatment systems because without oxygen there could be no growth of microorganisms or utilization of organic matter. A general discussion of the relationships of the various forms of combined oxygen to the microorganisms in biological systems is given.

September

1054. Stresses in Pressure Pipelines and Protective Casing Pipes, by M. G. Spangler. (ST) This paper contains an analytical study of stresses in steel pipelines under combined internal fluid pressure and external loads, such as earth backfill and surface traffic loads. Also, a study is made of the deflection of protective casing pipes at pipeline crossings beneath highways, railways, and airport runways.

1055. Prestressed Continuous Beams and Frames, by P. B. Morice and H. E. Lewis. (ST) This paper describes methods of design for continuous prestressed concrete beams and frames, in particular those of uniform section. Methods for determining suitable tendon profiles are discussed, and it is shown that certain displacements of profiles are possible without affecting the stress conditions. In the case of frames, consideration is given to the effects of varying direct force on section design. The methods of allowing for transom shortening due to prestress are discussed. A comparison is made between simply supported and continuous beam construction, showing that the use of continuity becomes advantageous only when large dead loads occur. It is also shown that the adoption of alternating long and short spans does not lead to economy.

1056. Response of a Rigid Frame to a Distributed Transient Loads, by R. C. DeHart. (ST) This paper presents a method for analyzing the response of a rigid frame structure subjected to a distributed lateral load of a transient nature. The structure is studied from the standpoint that it is a continuous system having a distributed mass. Time-dependent relations for deflections and moment are developed and these quantities are computed for one example.

1057. Hyperbolic Paraboloid and Other Shells of Double Curvature, by Alfred L.

ORDER FORM FOR PROCEEDINGS PAPERS

(For ASCE Member use only)

American Society of Civil Engineers
33 W. 39th St., New York 18, N. Y.

Please send me the PROCEEDINGS PAPERS which I have circled below.

1047 1048 1049 1050 1051 1052 1053 1054 1055 1056 1057 1058 1059 1060 1061
1062 1063 1064 1065 1066 1067 1068 1069

If more than one copy of a paper is desired (*for which a charge of 25¢ per copy will be levied*) indicate here:

Name (*please print*) Membership Grade

Address

Signature Date

Parme. (ST) The paper presents a comprehensive derivation of formulas for the evaluation of the membrane forces acting in any doubly curved shell. For the specific case of elliptical paraboloid shell, numerical tables are given for the ready determination of the stresses. The applicability of these tabular values to other shapes is shown and illustrative examples included.

1058. Moment Distribution Constants from Models, by Otakar Ondra. (ST) The paper describes an experimental method of determining carry-over and stiffness factors, fixed end moments, and displacement effects for beams with variable moments of inertia. The method is based on the concept of a three-dimensional M/EI solid whose properties are evaluated by weighing and the use of statics.

1059. Alternatives to Stone in Breakwater Construction, by Reuben J. Johnson and Olin F. Weymouth. (WW) The type of breakwater construction employed depends on economic considerations, depth and salinity of water, severity of storms, and availability of materials. The difficulty in obtaining armor stone has resulted in investigation of alternatives such as concrete castings in the form of rectangular blocks, tetrahedrons, and tetrapods. Advantages of this type of construction indicate increasing feasibility in future breakwater work.

1060. The Harrison County Artificial Beach, by F. F. Escoffier. (WW) Cooperative studies between Harrison County, Miss., and the Corps of Engineers (United States Department of the Army) led to the pumping of an artificial beach in front of the existing seawall. This beach is proving its value as a protection to the seawall and as a recreational facility.

1061. Growth of Commerce: Tennessee and Cumberland Rivers, by G. M. Dorland and G. R. Bethurum, Jr. (WW) The United States inland waterways system carried over 173 billion ton-miles of freight in 1955, an increase of 101 percent in the past quarter century. The Tennessee and Cumberland Rivers' growth in commerce has greatly exceeded the national average. This paper attempts to present reasons for this growth.

1062. Lower Cumberland Project: Kentucky and Tennessee, by A. E. Dykes. (WW) This $167,000,000 multipurpose project is a key element in the over-all plan of development of the water resources of the Cumberland River basin. It will be connected with the Tennessee River by a canal, providing for integrated operation with that system for flood control, navigation, hydroelectric power, and allied purposes.

1063. Arrangement of Groins on a Sandy Beach, by Shositiro Nagai. (WW) It is an important and difficult problem to arrange groins effectively for protection against erosion by wave action on a sandy coast. This paper will present the relation of the groins' length, space, and orientation with respect to the shoreline, the direction of wave propagation, and the breaking point of the breakers. The relationship between wave steepness and sand transport, and some results of experiments concerning special types of groins are also presented.

1064. Coordinated Surveying and Mapping for Industry, by E. D. Morse. (SU) The lasting economies and many advantages deriving from utilization of a plane coordinate system in surveying and mapping are generally acknowledged by civil engineers and land surveyors, although employment of such systems, particularly in industry, is not as widespread as is justified. Rapid expansion of industry, the need for greater precision and efficiency in surveying and mapping operations, and the availability of an increasing number of accurate and permanent control points keyed to the State Plane Coordinate System give added emphasis to this matter.

1065. Uses of Aerial Surveying in Highway Design and Location, by David K. Blythe. (SU) The use of aerial photographs in highway design and location is helping provide better highways for our country; they will play a vital role in the current road building program. This paper explains some of the uses of aerial photographs by citing their use in Kentucky Department of Highways projects.

1066. Discussion of Proceedings Paper 921. (SU) Sumner B. Irish, William A. White on 921.

1067. Discussions of Proceedings Papers 735, 763, 914, 915. (ST) A. S. Veletsos and N. M. Newmark closure to 735. Adrian Pauw closure to 763. A. C. Scordelis, Robert R. Dickey, A. A. Eremin, Jacob Karol on 914. A. A. Eremin, Edward Cohen and Edward Laing on 915.

1068. Discussion of Proceedings Papers 727, 801, 803. (WW) David A. Hopkins closure to 727. Rufus H. Carter, Jr., closure to 801. Walter F. Lawlor closure to 803.

1069. Design Considerations for a New Lock at Wilson Dam, by Robert A. Monroe and George P. Palo. (WW) Navigation of the Tennessee River has increased to such extent that the existing locks at Wilson Dam will soon be inadequate to handle the traffic. This paper discusses the major features of design of a new single-lift lock at Wilson Dam having a lock chamber 110 ft wide by 600 ft long, and with a maximum list of 100 ft.

KEY TO TECHNICAL DIVISION SPONSORSHIP

(AT) Air Transport
(CP) City Planning
(CO) Construction
(EM) Engineering Mechanics
(HW) Highway
(HY) Hydraulics
(IR) Irrigation and Drainage
(PI) Pipeline Division
(PO) Power
(SA) Sanitary Engineering
(SM) Soil Mechanics and Foundations
(ST) Structural
(SU) Surveying and Mapping
(WW) Waterways and Harbors

Professional Services

Listed alphabetically by states

PALMER & BAKER, INC.
Consulting Engineers and Architects
Tunnels — Bridges — Highways — Airports — Industrial Buildings — Harbor Structures — Soils, Materials & Chemical Laboratories
Mobile, Ala. **New Orleans, La.**
Harvey, La.

JOHN S. COTTON
Consulting Engineer
Hydroelectric, irrigation, water supply, and multiple purpose projects, flood and erosion control, river basin development planning, dams and their foundations, tunnels, marine structures, valuations, rates.
24 Evergreen Drive, Kentfield, Calif.

DAMES & MOORE
Soil Mechanics Engineering
Los Angeles • San Francisco • Portland
Seattle • Salt Lake City • Chicago
New York • Atlanta • London
General Offices, 816 West Fifth Street
Los Angeles 17, Calif.

FAIRCHILD AERIAL SURVEYS INC.
Aerial Photography • Contour Maps
Airborne Geophysical Surveys
Highway Maps • City Maps
224 E. 11th St., Los Angeles 15
New York • Chicago • Atlanta • Boston

MAURSETH & HOWE
Foundation Engineers
Soil Investigations—Laboratory Testing
Consultants—Engineering Geology
Construction Supervision
Offices and Laboratories: **Eastern Associate:**
2601 South Hill St. **George R. Halton**
Los Angeles 7, Calif. **Newark, N. J.**

KAISER ENGINEERS
Division of Henry J. Kaiser Company
ENGINEER - CONTRACTOR
Investigations - Reports - Valuations
Design - Construction
Twinoaks 3-4600
1924 Broadway **Oakland, Calif.**

INTERNATIONAL ENGINEERING COMPANY INC.
Engineers
Investigations—Reports—Design
Procurement—Field Engineering
Domestic and Foreign
74 New Montgomery St.
San Francisco 5, California

SAENZ-CANCIO-MARTIN
Ingenieros
Design and Supervision
Structural, Topographic, Soils and Hydraulic Engineering
Ave. de la Independencia 774
Ensanche del Vedado
Habana, Cuba

DUVAL ENGINEERING & CONTRACTING CO.
General Contractors
FOUNDATION BORINGS
For Engineers and Architects
Jacksonville **Florida**

RADER ENGINEERING CO.
Water Works, Sewers, Refuse Disposal, Ports, Harbors, Flood Control, Bridges, Tunnels, Highways, Airports, Traffic, Foundations, Buildings, Reports, Investigations, Consultations
111 N.E. 2nd Avenue Miami, Florida

ALVORD BURDICK & HOWSON
Consulting Engineers
Water Works, Sewerage, Water Purification, Sewage Treatment, Flood Relief, Power Generation, Drainage, Appraisals.
20 North Wacker Drive, Chicago 6, Ill.

CONSOER, TOWNSEND & ASSOCIATES
Water Supply, Sewerage, Flood Control & Drainage, Bridges, Express Highways, Paving, Power Plants, Appraisals, Reports, Traffic Studies, Airports, Gas and Electric Transmission Lines
351 East Ohio Street, Chicago 11, Ill.
9½ Indiana St., Greencastle, Ind.

DeLEUW, CATHER & COMPANY
Consulting Engineers
Transportation, Public Transit and Traffic Problems
Industrial Plants, Grade Separations, Railroads, Subways, Power Plants, Expressways, Tunnels, Municipal Works
150 N. Wacker Drive, 79 McAlister St.
Chicago 6, Ill. **San Francisco 2**

GREELEY AND HANSEN
Samuel A. Greeley, Paul E. Langdon, Thomas M. Niles, Kenneth V. Hill, Samuel M. Clarke, Richard H. Gould
Water Supply, Water Purification, Sewerage, Sewage Treatment, Refuse Disposal, Industrial Wastes
220 S. State Street, Chicago 4, Ill.

HARZA ENGINEERING COMPANY
Consulting Engineers
Calvin V. Davis **E. Montford Fucik**
Richard D. Harza
Hydroelectric Plants and Dams
Transmission Lines
Flood Control, Irrigation
River Basin Development
400 West Madison Street **Chicago 6**

HAZELET & ERDAL
Consulting Engineers
Bridges—Foundations
Expressways—Dams—Reports
Monadnock Block, Chicago
405 Commerce Bldg., Louisville
Dixie Terminal Bldg., Cincinnati

C. MARTIN RIEDEL
Consulting Engineer
Chemical Soil Solidification Engineering for Tunnels, Shafts, Mines, Foundations, Underground Structures
7650 S. Laflin St. **Chicago 20, Ill.**
Tel: Vincennes 6-6022, -23

SOIL TESTING SERVICES, INC.
Consulting Engineers
John P. Gnaedinger
Carl A. Metz
Soil Investigations,
Foundation Recommendations and Design,
Laboratory Testing
3521 N. Cicero Avenue, Chicago 41, Ill.
Milwaukee, Wis.—Portland, Michigan
Kenilworth, N. J.—San Francisco, Calif.
Havana, Cuba

JENKINS, MERCHANT & NANKIVIL
Consulting Engineers
Municipal Improvements — Sewerage
Power Development — Water Systems
Traffic Surveys — Industrial Plants
Flood Control — Recreational Facilities
Airports — Investigations and Reports
805 East Miller Street
Springfield, Illinois

NED L. ASHTON
Consulting Engineer
Bridges, Swimming Pools, Welded Structures & Foundations, Design & Strengthening
820 Park Road **Iowa City, Iowa**

STANLEY ENGINEERING COMPANY
Consulting Engineers
208 S. LaSalle Street **Hershey Building**
Chicago 4, Illinois **Muscatine, Iowa**

EUSTIS ENGINEERING COMPANY
FOUNDATION AND SOIL MECHANICS INVESTIGATIONS
Soil Borings — *Laboratory Tests*
Foundation Analyses — *Reports*
3635 Airline Highway
Metairie, Louisiana

FROMHERZ ENGINEERS
Structural—Civil—Sanitary
Four Generations Since 1867
Water Supply, Sewerage, Structures, Drainage, Foundations, Industrial Waste Disposal
Investigations, Reports, Plans and Specifications, Supervision
816 Howard Avenue
New Orleans

WHITMAN, REQUARDT AND ASSOCIATES
Engineers
Sewerage and Water Systems, Highways, Airports, Industrial and Power Plants and Other Structures
Reports — Designs — Specifications — Supervision
1304 St. Paul Street **Baltimore 2, Md.**

MADDOX AND HOPKINS
Engineers & Surveyors
Plane and Geodetic Surveys
Topographic Maps—Photogrammetry
Highways, Utilities, Structures
8506 Dixon Ave. **Silver Spring, Md.**

CLARKESON ENGINEERING COMPANY, INC.
Highways, Bridges, Structures, Airports, Dams, Traffic Surveys, Reports, Waterfront Facilities
285 Columbus Avenue
Boston 16, Massachusetts

TECHNICAL DIVISION

ENROLLMENT FORM

American Society of Civil Engineers
33 West 39th Street
New York 18, New York

☐ I am already enrolled
or
☐ I wish to be enrolled
in the.....
Division and receive automatically the Journal of that Division.

In addition, I wish to be enrolled in the
.....
Division and receive automatically the Journal of that Division.

(Enrollment becomes effective 30 days after receipt of this form)

(Signature)

(Please print name) (Membership grade)

PLEASE PRINT MAILING ADDRESS ONLY

(Number and Street)

(City) (State)

Professional Services

Listed alphabetically by states

FAY, SPOFFORD & THORNDIKE, INC.
Engineers

Airports, Bridges, Turnpikes
Water Supply, Sewerage and Drainage
Port and Terminal Works, Industrial Bldgs.
Boston, Massachusetts

JACKSON & MORELAND, INC.
Engineers and Consultants

Design and Supervision of Construction
Reports—Examinations—Appraisals
Machine Design—Technical Publications
Boston **New York**

METCALF & EDDY
Engineers

Investigations Reports Design
Supervision of Construction
and Operation
Management Valuation Laboratory
Statler Building
Boston 16

BENJAMIN S. SHIENWALD
Architectural Consultants
on
Engineering Projects
Design—Supervision—Reports
85 South Street, Boston 11, Mass.

The Thompson & Lichtner Co., Inc.
Civil and Industrial Engineers

Design, Supervision, Testing,
Engineering and Production Studies.
Special Structures, Tunnels, Airports,
Highways, Foundations.
Office and Laboratory–Brookline, Mass.

CRANDALL DRY DOCK ENGINEERS, INC.

Railway Dry Docks, Floating Dry Docks,
Basin Dry Docks, Shipyards,
Port Facilities
Investigation, Reports, Design
238 Main St. **Cambridge 42, Mass.**

GARRITY & MOSHER
Engineers
Leo V. Garrity **L. W. Mosher**
Municipal and Industrial Water and
Sewage Works
Water System Analyses
Tunnels and Foundations
Reports, Designs, Plans and Specifications
14050 W. McNichols Rd.
Detroit 35, Mich.

BLACK & VEATCH
Consulting Engineers

Water—Sewage—Electricity—Industry,
Reports, Design Supervision of Construction Investigations, Valuation and Rates.
4706 Broadway **Kansas City 2, Mo.**

BURNS & McDONNELL
Engineers-Architects-Consultants

Kansas City, Missouri **Phone**
P. O. Box 7088 **DElmar 3-4375**

GUNITE CONCRETE & CONSTRUCTION COMPANY
Engineers—Cement Gun Specialists—Contractors
Linings, Encasing, Insulating, Repairing,
Fireproofing, New Construction
1301 Woodweather Rd., Kansas City 5
2016 West Walnut, Chicago 12, Illinois
3206 Houston, Houston 9, Texas
4961 Olive Street, St. Louis 8, Mo.
Milwaukee and Twin Cities—Denver—New Orleans

SVERDRUP & PARCEL, INC.
Engineers — Architects
Bridges, Structures and Reports
Industrial and Power Plant
Engineering
915 Olive Street **St. Louis 1, Mo.**
417 Montgomery St., **San Francisco 4, Cal.**

HAROLD HOSKINS & ASSOCIATES
(Successors to Scott & Scott, Inc.)
Consulting Engineers
Sewers and Sewage Treatment
Paving Water Supply Drainage
Bridges Airports Reports
Power Plants Surveys
1630 Que St., Lincoln 8, Nebr.
725-9th St., Greeley, Colorado

A. L. ALIN
Consulting Engineer
5927 N. 24 St.
Omaha, Nebraska

Dams, Hydroelectric Power
Flood Control

GOODKIND & O'DEA
Consulting Engineers
Design and Supervision
Foundations, Structures, Highways
610 Bloomfield Ave., Bloomfield, N. J.
1214 Dixwell Avenue, Hamden, Conn.
30 Church Street, New York, N. Y.

GREER ENGINEERING Associates
Foundation Designs and Analyses
Airphoto Soils and Geological Mapping
Undisturbed Sample Borings
Field and Laboratory Soil Tests
Geological Studies for Engineering Projects
Earth Dam Design and Control
98 Greenwood Ave., Montclair, N. J.

EDWARDS, KELCEY AND BECK
Consulting Engineers
Reports, Design, Supervision,
Subways, Expressways, Traffic, Parking,
Harbor Works, Bridges, Tunnels,
Housing and Industrial Developments
Newark, N. J.
New York **Philadelphia** **Boston**

PORTER, URQUHART, McCREARY & O'BRIEN
O. J. Porter & Co.
Consulting Engineers
Airports—Highways—Dams—Structures
Foundations—Stabilization—Pavements
415 Frelinghuysen Ave., Newark 5, N. J.
625 Eighth Ave., New York 18, N. Y.
3568 West Third St., Los Angeles 5, Calif.
516 Ninth St. **Sacramento 14, Calif.**
503 Market St., San Francisco 5, Calif.

BERGER ASSOCIATES
Consulting Engineers
Studies Design Supervision
Expressways Airfields
Structures Foundations
177 Oakwood Ave., Orange, N. J.
2nd and Locust Sts. Harrisburg, Penna.
Baltimore, Md.

JOSEPH S. WARD
Consulting Soil and Foundation Engineeer
Site Investigations—Laboratory Soil Testing — Foundation Analysis — Airports —Engineering Reports and Consultation
605 Valley Road
Upper Montclair, N. J.

AMMANN & WHITNEY
Consulting Engineers
Design and Construction Supervision of Bridges, Highways, Expressways, Buildings, Special Structures, Airport Facilities
111 Eighth Avenue, New York 11, N. Y.
724 E. Mason St., Milwaukee 2, Wisc.

BOGERT AND CHILDS
Consulting Engineers
Clinton L. Bogert Fred S. Childs
Ivan L. Bogert Donald M. Ditmars
Robert A. Lincoln Charles A. Manganaro
William Martin
Water and Sewage Works • Refuse Disposal • Drainage • Flood Control • Highways & Bridges • Airfields
145 East 32nd St., New York 16, N. Y.

BOWE, ALBERTSON & ASSOCIATE
Engineers
Sewage and Water Works—Industrial Wastes — Refuse Disposal — Municipal Projects — Industrial Buildings — Reports Plans — Specifications — Supervision of Construction and Operation—Valuation Laboratory Service
75 West Street **New York 6, N. Y.**

FRANK L. EHASZ
Consulting Engineers
Highways, Expressways, Bridges,
Buildings, Port Development, Airports,
Dams, Flood Control, Tunnels,
Sewerage, Water Supply
40-29 27th Street
Long Island City 1, N. Y.

THE FOUNDATION COMPANY
Engineered Construction
Power Plants — Drydocks — Bridges
Deep Caissons — Shipways
Heavy Foundations
THE FOUNDATION COMPANY
57 William Street, New York 5, N. Y.
BO 9-8111

HARDESTY & HANOVER
Consulting Engineers
Long Span and Movable Bridges, Hanover Skew Bascule, Grade Eliminations, Foundations, Expressways and Thruways, Other Structures, Supervision, Appraisals and Reports.
101 Park Avenue, New York 17, N. Y.

FREDERIC R. HARRIS, INC.
Consulting Engineers
Reports • Feasibility Studies • Evaluations
Designs • Port Development • Foundations
Highways and Bridges
Shipyards • Marine Structures
Floating Dry Docks • Graving Docks
Bulkheads • Piers • Wharves
Power Plants • Industrial Buildings
27 William Street, New York 5, N. Y.
1915 Tulane Avenue, New Orleans, La.

HAZEN AND SAWYER
Engineers
Water and Sewage Works
Industrial Waste Disposal
Drainage and Flood Control
Reports, Design, Supervision
of Construction and Operation
Appraisals and Rates
122 East 42nd St., **3333 Book Tower**
New York 17, N. Y. **Detroit 26, Mich.**

USE THIS PROFESSIONAL CARD DIRECTORY

Participation is restricted to consulting engineering firms operated or controlled by ASCE members.

B. K. HOUGH
Consulting Engineer
Soil & Foundation Engineering
Site Investigation, Soil Testing, Design Analysis for Earthworks, Foundations and Pavements, Field Inspection, Engineering Reports, Consultation
121 E. Seneca St. **Ithaca, New York**

HOWARD, NEEDLES, TAMMEN & BERGENDOFF
Consulting Engineers
Bridges, Structures, Foundations
Express Highways
Administrative Services
1805 Grand Avenue **55 Liberty Street**
Kansas City 6, Mo. **New York 5, N. Y.**

KING & GAVARIS
Consulting Engineers
Bridges Highways Toll Roads
—Arterials—Foundations—
Reports Investigations Surveys
Supervision of Construction
425 Lexington Ave. **New York**

LEGGETTE, BRASHEARS & GRAHAM
Consulting Ground Water Geologists
Water Supply, Salt Water Problems,
Dewatering, Recharging, Investigations,
Reports.
551 Fifth Avenue, New York 17, N. Y.

LOCKWOOD, KESSLER & BARTLETT, INC.
Engineers *Surveyors*
Civil Engineering Investigations, Reports, and Designs, Supervision of Construction, Cadastral, Geodetic, Topographic & Engineering Surveys, Photogrammetric Engineering and Mapping
375 Great Neck Rd., Great Neck, N. Y.

MORAN, PROCTOR, MUESER & RUTLEDGE
Consulting Engineers
Foundations for Buildings, Bridges and Dams, Tunnels, Bulkheads, Marine Structures, Soil Studies and Tests, Reports, Design and Supervision.
415 Madison Ave., New York 17, N. Y.

PARSONS, BRINCKERHOFF HALL & MACDONALD
Engineers
Bridges, Highways, Tunnels, Airports, Subways, Harbor Works, Dams, Canals, Traffic, Parking and Transportation Reports, Power, Industrial Buildings, Housing, Sewerage and Water Supply.
51 Broadway **New York 6, N. Y.**

E. LIONEL PAVLO
Consulting Engineer
Design, Supervision, Reports
Bridges, Highways, Expressways
Marine Structures, Industrial Construction, Public Works, Airports
7 E. 47th St. **New York 17, N. Y.**

Professional Services

Listed alphabetically by states

MALCOLM PIRNIE ENGINEERS
Civil & Sanitary Engineers
Malcolm Pirnie **Ernest W. Whitlock**
Robert D. Mitchell **Carl A. Arenander**
Malcolm Pirnie, Jr.
Investigations, Reports, Plans
Supervision of Construction
and Operations
Appraisals and Rates
25 W. 43rd Street, New York 36, N. Y.

THE PITOMETER ASSOCIATES, INC.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurement and Special
Hydraulic Investigations
New York, 50 Church St.

ALEXANDER POTTER ASSOCIATES
Consulting Engineers
Water Works Sewerage, Drainage, Refuse Incinerators, Industrial Wastes, City Planning
50 Church Street, New York 7, N. Y.

PRAEGER-KAVANAGH
Engineers
126 East 38th St., New York 16, N. Y.

SEELYE STEVENSON VALUE & KNECHT
CONSULTING ENGINEERS
Richard E. Dougherty, Consultant
Manufacturing Plants
Heavy Engineering
Structural Mechanical Electrical
101 Park Ave. **New York 17, N. Y.**

SEVERUD-ELSTAD-KRUEGER
Consulting Engineers
Structural Design—Supervision—Reports
Buildings—Airports—Special Structures
415 Lexington Ave., New York 17, N.Y.

SINGSTAD & BAILLIE
Consulting Engineers
Ole Singstad **David G. Baillie, Jr.**
Tunnels, Subways, Highways, Foundations, Parking Garages
Investigations, Reports, Design, Specifications, Supervision
24 State St. **New York 4, N. Y.**

FREDERICK SNARE CORPORATION
Engineers-Contractors
Harbor Works, Bridges, Power Plants
Dams, Docks and Foundations
233 Broadway, New York 7, N. Y.
Santiago, Chile **San Juan, P. R.**
Havana, Cuba **Lima, Peru**
Bogota, Colombie **Caracas, Venezuela**

D. B. STEINMAN
Consulting Engineer
BRIDGES
Design, Construction, Investigation, Reports, Strengthening, Advisory Service
117 Liberty Street, New York 6, N. Y.

TIPPETTS-ABBETT-McCARTHY-STRATTON
Engineers
Ports, Harbors, Flood Control Irrigation
Power, Dams, Bridges, Tunnels
Highways—Railroads
Subways, Airports, Traffic, Foundations
Water Supply, Sewerage, Reports
Design, Supervision, Consultation
62 West 47th Street, New York City

THE J. G. WHITE ENGINEERING CORPORATION
Engineers & Constructors
80 Broad St., New York 4, N. Y.

THE AUSTIN COMPANY
Design — Construction — Reports
Plant Location Surveys — Domestic & Foreign Work
1611? Euclid Avenue, Cleveland, Ohio
New York **Detroit** **Oakland**
Chicago **Houston** **Seattle**
Los Angeles

HAVENS AND EMERSON
W. L. Havens **A. A. Burger**
J. W. Avery **H. H. Moseley**
F. S. Palocsay **E. S. Ordway**
Frank C. Tolles, Consultant
Consulting Engineers
Water, Sewerage, Garbage, Industrial Wastes, Valuations—Laboratories
Leader Bldg. **Woolworth Bldg.**
Cleveland 14, O. **New York 7, N. Y.**

THE OSBORN ENGINEERING COMPANY
Designing—Consulting
Industrial Plants Office Buildings
Stadiums Grand Stands Field Houses
Bridges Garages Laboratories
7016 Euclid Ave. **Cleveland 3, Ohio**

YULE, STICKLEN, JORDAN & McNEE
Engineers
Highways, Bridges, Airports
Design, Investigations, Reports
Supervision of Construction
Civil, Structural, Mechanical, Electrical
23rd & Markets **309 South Broad St.**
Camp Hill, Pa. **Philadelphia 7, Pa.**
5564 North High St.
Columbus, Ohio

CAPITOL ENGINEERING CORPORATION
Engineers-Constructors-Management
DESIGN AND SURVEYS
ROADS AND STREETS
SEWER SYSTEMS WATER WORKS
PLANNING AIRPORTS
BRIDGES TURNPIKES DAMS
Executive Offices
Dillsburg, Pennsylvania
Washington, D. C. **Pittsburgh, Pa.**
Dallas, Texas **Paris, France**

GANNETT FLEMING CORDDRY & CARPENTER, INC.
Engineers
Dams, Water Works, Sewage, Industrial Waste and Garbage Disposal—Highways Bridges and Airports, Traffic and Parking —Appraisals, Investigations, and Reports
HARRISBURG, PENNA.
Pittsburgh, Pa. **Philadelphia, Pa.**
Daytona Beach, Fla. **Pleasantville, N.J.**

MODJESKI AND MASTERS
Consulting Engineers
F. M. Masters
G. H. Randall **J. R. Giese**
C. W. Hanson **H. J. Engel**
Design and Supervision of Construction
Inspection and Reports
Bridges, Structures and Foundations
State St. Bldg. **Philadelphia, Pa.**
Harrisburg, Pa. **New Orleans, La.**

ALBRIGHT & FRIEL INC. CONSULTING ENGINEERS
Water, Sewage, Industrial Wastes and Incineration Problems, City Planning, Highways, Bridges and Airports, Dams, Flood Control, Industrial Buildings, Investigations, Reports, Appraisals and Rates.
THREE PENN CENTER PLAZA PHILADELPHIA 2, PA.

JUSTIN & COURTNEY
Consulting Engineers
Joel B. Justin **Neville C. Courtney**
Dams and Power Problems
Hydro Electric Developments
Foundations
121 S. Broad St. **Philadelphia 7, Pa.**

MORRIS KNOWLES INC.
Engineers
Water Supply and Purification
Sewerage and Sewage Disposal
Valuations, Laboratory, City Planning
1312 Park Bldg., Pittsburgh 22, Pa.

H. A. KULJIAN & COMPANY
Engineers and Architects
Power Plants (steam, hydro, diesel)
Industrial Buildings • Army & Navy Installations • Airports, Hangars
Water & Sewage Works
Design • Investigations • Reports • Surveys
1200 NO. BROAD ST. PHILA. 21, PA.

G. G. GREULICH
Consulting Engineer
Research, Development, and Market Surveys on Fabricated Metal Products. Pile Foundations, Cofferdams, and Bulkheads. Bridge Floors. Bank Vaults. Industrial Plants and Office Buildings
Two Gateway Center, Pittsburgh 22, Pa.

HUNTING, LARSEN & DUNNELLS
Engineers
Industrial Plants—Warehouses
Commercial Buildings—Office Buildings
Laboratories—Steel and Reinforced Concrete Design—Supervision
Reports
1150 Century Bldg., Pittsburgh 22, Pa.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Surveys—Design—Supervision
Sanitary Engineering
Industrials and Utilities
Domestic and Foreign
607 Washington St.
Reading, Pa.
New York — Washington

MICHAEL BAKER, JR., INC.
The Baker Engineers
Civil Engineers, Planners, and Surveyors
Airports—Highways—Sewage Disposal Systems—Water Works Design and Operation—City Planning—Municipal Engineering—All Types of Surveys
Home Office: Rochester, Pa.
Branch Office:
Jackson, Miss. **Harrisburg, Pa.**

SPRAGUE & HENWOOD, INC.
Foundation Investigations—Soil Testing & Test Borings—Grout Hole Drilling & Pressure Grouting—Diamond Core Drilling
221 W. Olive St., Scranton, Pa.
1009 Western Savings Fund Bldg., Phila., Pa.
11 W. 42nd St., New York, N. Y.
200 Magee Bldg., Pittsburgh, Pa.
Box 645 Grand Junction, Colorado
Buchans, Newfoundland

C. W. RIVA CO.
Edgar P. Snow **John F. Westman**
Highways, Bridges, Tunnels, Airports, Sewerage, Water Supply, Soil Tests, Reports, Design and Supervision
511 Westminister St. **Prov. 3, R. I.**

JACK R. BARNES
Consulting Ground-Water Engineer
Exploration—Evaluation—Development of Underground Water Supplies
308 W. 15th St. **Tel. 7-5407**
Austin, Texas **53-4751**

WILLIAM F. GUYTON AND ASSOCIATES
Consulting Ground-Water Hydrologists
Underground Water Supplies.
Investigations, Reports, Advice.
307 W. 12th St. **3301 Monrose Blvd.**
Austin 1, Texas **Houston 6, Texas**
Phone: GR 7-7165 **Phone: JA 2-9885**

ENGINEERS TESTING LABORATORY, INC.
Foundation and Soil Mechanics Investigations
Soil Borings Laboratory Tests
Foundation Analyses Reports
2116 Canada Dry St., Houston 23, Texas

LOCKWOOD, ANDREWS & NEWNAM
Consulting Engineers
Industrial Plants, Harbors, Public Works
Roads, Airport, Structures, Earthworks
Mechanical & Electrical
Reports—Design—Supervision
Surveys—Valuations
Corpus Christi-HOUSTON-Victoria, Texas

McCLELLAND ENGINEERS
SOIL & FOUNDATION CONSULTANTS
INVESTIGATION • REPORTS
SUPERVISION • BORINGS & TESTS
2649 N. Main **Houston 9, Tex.**

NATIONAL SOIL SERVICES
Consulting Engineers
Soils—Foundations—Groundwater
Ralph F. Reuss **Ray E. Hurst**
Soil Borings Laboratory Tests
Foundation Analyses and Reports
Groundwater Exploration and Evaluation
M. & M. Building **Houston, Texas**

Index to Advertisers

Advertising Manager

James T. Norton

Advertising Production Manager

Alice M. Doerle

33 West 39th Street, New York 18, N. Y.

Representatives

EASTERN

• ROBERT S. CYPHER
33 West 39th Street, New York 18, N. Y.

SOUTHEASTERN

• Fred W. Smith
1212 41st St., B. H.
Birmingham 8, Ala.

MID-WESTERN

• DWIGHT EARLY AND SONS
100 North La Salle St., Chicago 2, Ill.

WESTERN

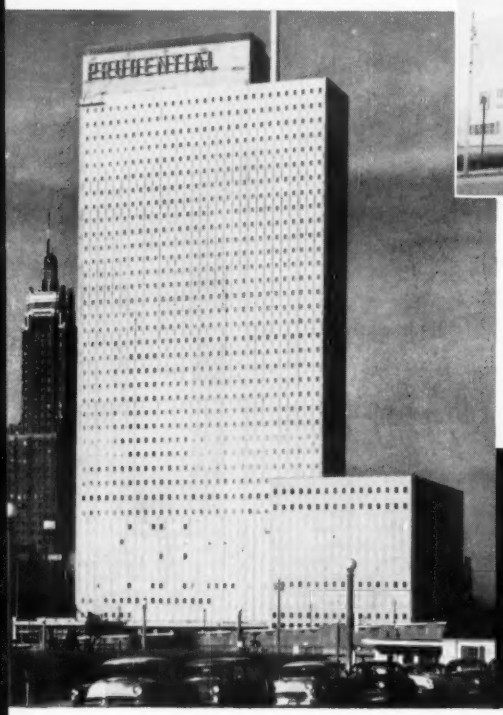
• McDONALD-THOMPSON COMPANY
625 Market St., San Francisco 5, Calif.
3727 West Sixth St., Los Angeles 5, Calif.
National Bldg., 1008 Western Ave., Seattle, Wash.
5526 Dyer Street, Dallas 6, Texas
3217 Montrose Boulevard, Houston 6, Texas
Colorado National Bank Bldg., Denver 2, Colo.

PRUDENTIAL

INSURANCE COMPANY OF AMERICA

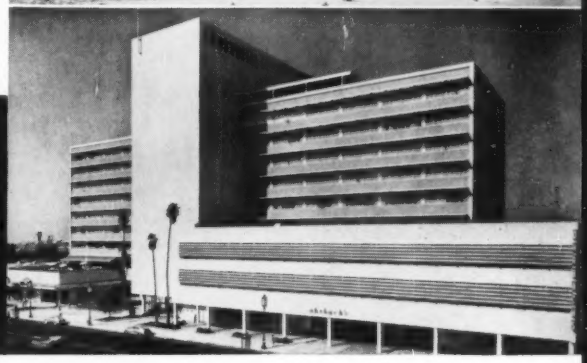
Left—Prudential Insurance Bldg., Jacksonville, Fla. Archt.—Kemp, Bunch & Jackson; Contr.—Daniel Construction Co. Pozzolith Ready-Mixed Concrete supplied by Capitol Concrete Co.—all of Jacksonville.

Below—Prudential Office Building, Minneapolis, Minn. Archt. and Engr.—Magney, Tusler & Setter; Contr.—C.F. Haglin & Sons Co. Pozzolith Ready-Mixed Concrete supplied by Ready-Mixed Concrete Co.—all of Minneapolis.



Left—Prudential Building, Chicago, Illinois. Archt.-Eng.—Naess & Murphy; Contr.—Geo. A. Fuller Co.; Pozzolith Ready-Mixed Concrete supplied by Material Service Corp.—all of Chicago.

Right—Prudential Insurance Co., Los Angeles, Calif. Archts.—Walter Wurdeman and Welton Becket; Engr.—Murray Erick Associates; Gen. Contr.—Wm. Simpson Co.—all of Los Angeles. Pozzolith Ready-Mixed Concrete supplied by Transit Mixed Concrete Co., Pasadena.



POZZOLITH employed for improved control of Concrete Quality...

"for the same owner time and time again"

These outstanding Prudential office buildings are representative of the many structures—often for the same owner time and time again—where Pozzolith has proved a valuable aid in economically obtaining concrete of desired properties. This is because Pozzolith provides the following three controls required for optimum concrete performance.

1. ***Control of water content***...lowest possible unit water content for a given workability. Results in greatly improved concrete quality and economy.
2. ***Control of entrained air***...for designed strength with required durability and low permeability.
3. ***Control of rate of hardening***...for speed where needed, for retardation where required—in any event good uniform concrete.

Any of our more than 75 field technical men will be glad to demonstrate the full advantages of Pozzolith for *your* project.

COLORED MOTION PICTURE, "The Man With The Trowel", shows how Pozzolith and its adaptations—through control of water, air and rate of hardening—greatly improve your control of concrete quality. Film available for private showing to groups of any size.

MASTER BUILDERS PRODUCTS

the MASTER BUILDERS co.

Division of American-Marietta Company

Cleveland 3, Ohio — Toronto 9, Ontario Cable Address, Mastmethod, N.Y.

TO THE ENDS OF THE EARTH...

From Canada to South Africa—
from the Pacific Ocean to the Near East—
Lock Joint Concrete Pressure Pipe
continues unfailingly to bring life-giving water
to cities, farms and industries.

Engineers and water works officials
of many countries have shopped the world and, like
so many of their fellow experts in the United States,
have chosen Lock Joint Concrete Pressure Pipe
as the most durable, dependable and
economical medium for the construction of their
vital water supply and distribution lines.

You cannot do better than to follow their example
and specify LOCK JOINT.

LOCK JOINT PIPE CO.

East Orange, New Jersey

Sales Offices: Chicago, Ill. • Columbia, S. C. • Denver, Col. • Detroit, Mich. • Hartford, Conn. • Kansas City, Mo.

Pressure • Water • Sewer • REINFORCED CONCRETE PIPE • Culvert • Subaqueous